SCIENCE

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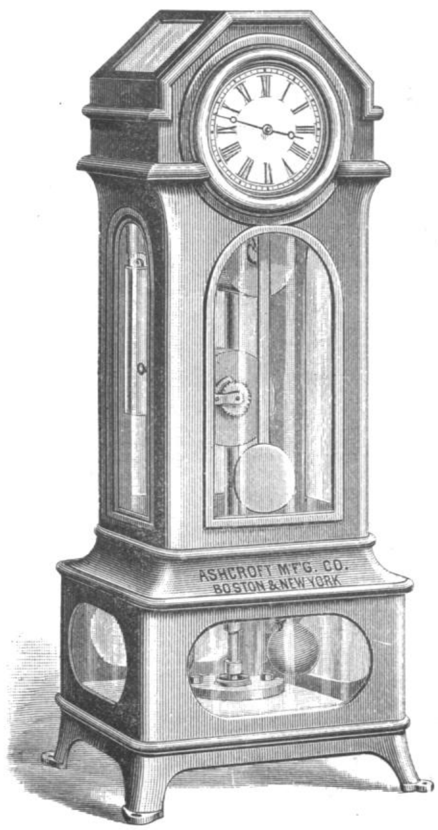
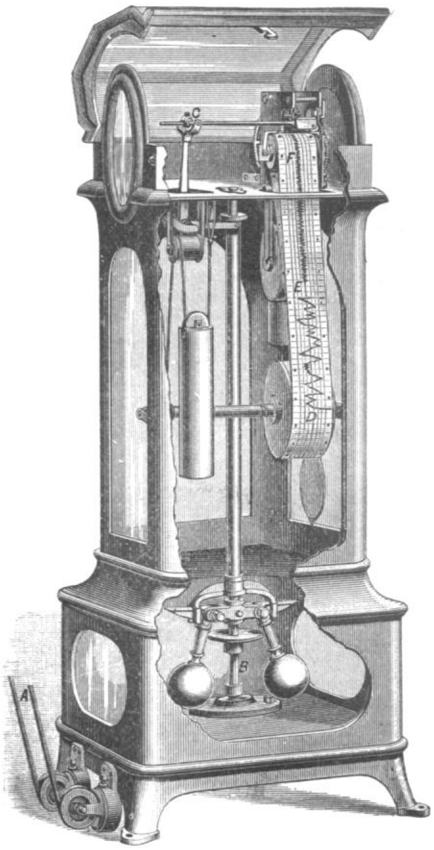
THE MOSCROP CONTINUOUS RECORDER.

THIS instrument was invented by J. B. Moscrop of Manchester, England, who designed it especially for the use of manufacturers of textile fabrics. Its services proved so valuable that its use rapidly extended, not only in Europe, but also in this country. It has found a place in many woollen and cotton mills, electric-light stations, and other places where it is desired to keep an accurate record of the time of starting and stopping an engine, as well as of all variations from a standard speed, with the exact time and extent of such variation.

The instrument consists of an iron case with glass sides, containing an eight-day pendulum clock, which moves a continuous paper band. Upon this band the record is traced by an inked marker, which is actuated by the motion of the governor-balls as they rise and fall under varying speed. Fig. 1 shows the general appearance of the instrument, and Fig. 2 gives a side view with part of the frame removed, showing the clock-movement and the interior construction. The governor-shaft is actuated by the belt *A*, which transmits motion from the shaft whose speed it is desired to record to a pulley on the lower end of the upright shaft which rises through the middle of the instrument. To this shaft is attached a governor, the balls of which rise by centrifugal force when the shaft is revolved. By means of connecting devices, the motion of the balls is transmitted to a horizontal arm at the top of the case. This arm carries a marker, which is movable across the paper band upon which the record is to be made.

When the engine is running steadily at the standard speed, the marker rests at a central longitudinal line on the paper. Sections of this paper are shown at Figs. 3 and 4. Should the speed of the engine be increased or decreased five per cent, the marker would pass to the next line to the right or left, each space passed over indicating a variation of five per cent in the speed. When the engine is stopped, the marker passes entirely off the paper, and makes no record until it is brought back to the paper by the starting of the





FIGS. 1 AND 2.—THE MOSCROP RECORDER.

engine. As each transverse space on the paper indicates one hour, and as the paper is moved ahead at unvarying speed by the clock, the length of the interval between the starting and stopping of the engine is recorded, also the moment and extent of all variations of speed. One paper band is sufficient for a three-months' run.

Figs. 3 and 4 are copies of actual records taken from different engines, and taken together, show the workings of the instrument under different circumstances. The section marked 1 is almost perfection. The record begins at one minute past seven, and continues till 7.15; the narrow line showing plenty of fly-wheel momentum, and the straight line good governing. Section 2, 7.15 to

7.30, illustrates small fly-wheel combined with good governing. The fly-wheel unsteadiness is five per cent. Section 3, 7.30 to 7.45, illustrates great fly-wheel momentum, governing rather imperfect. Here the speed decreased one per cent by 7.45. As the decrease was gradual, the probability is that it was caused by the steam being down, and the governing not equal to the occasion. Section 4, 7.45 to 8, illustrates small fly-wheel momentum and imperfect governing. Here the speed suddenly increased two and one-half per cent at 7.50. This would appear to be, by its suddenness, a change in the load and governing not equal to the occasion. Section 5, 8 to 8.14, looks like mule-spinning and throttle-valve. Section 6, 8.15 to 8.30, is frequently met. Without doubt, the governing-gear began to stick at 8.18, the speed oscillating twelve per cent till 8.25. The oscillations have their ebb and flow in periods of a few seconds, and are the unsuspected cause of bad work. This is a good instance of an engine running its natural speed, yet being all the while dangerously unsteady, subjecting the weak part of the engine and gearing to a severe test. Sections 7 and 8, 8.30 to 9, illustrates respectable mediocrity. It is introduced to show that at 8.46 the record stopped through the belt being off.

As one of the objects in these illustrations is to make the reading of the records intelligible, we will now assume that the engine stopped from 9 to 9.30 for repairs. Sections 9, 10, 11, and 12 are diagrams from the same engine; 9 is the diagram when the recorder was first applied; 10, 11, and 12 are stages in the improvement in the engine's workings as the faults are remedied. Sections 13 and 14 are another instance of improved running. This engine has been speeded two and a half per cent, and yet never attained the speed it formerly attained during its oscillations. It is now always at its highest speed, combining steady turning with maximum turnout. If an engine is making 60 revolutions, and it proves to be oscillating in steadiness from 59 to 61, it is obvious that it is either running too quickly for good work at 61, or it is losing output when at 59. Sections 15, 16, and 17 are from the same engine, and are placed here to show vividly the advantage in steadiness of turning of having an engine lightly loaded. Section 15 is the record of full load, that is, 450 horse-power; section 16, the record with a partial load, that is, 250 horse-power; 17, with a small load, that is, 150 horse-power. This engine was fitted with a supplementary governor, recently patented, and it is worthy of note that it preserved its speed (automatic cut-off) under a change of load from 450 horse-power to 150 horse-power. It was subjected to a similar test with a varied pressure, giving equally good results.

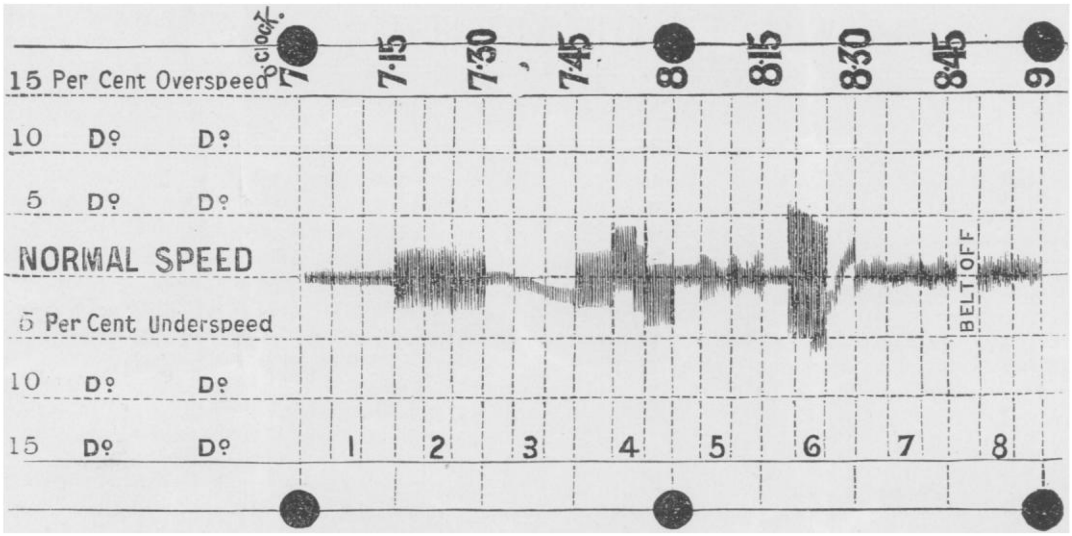


FIG. 3. — MOSCROP RECORDER RECORD.

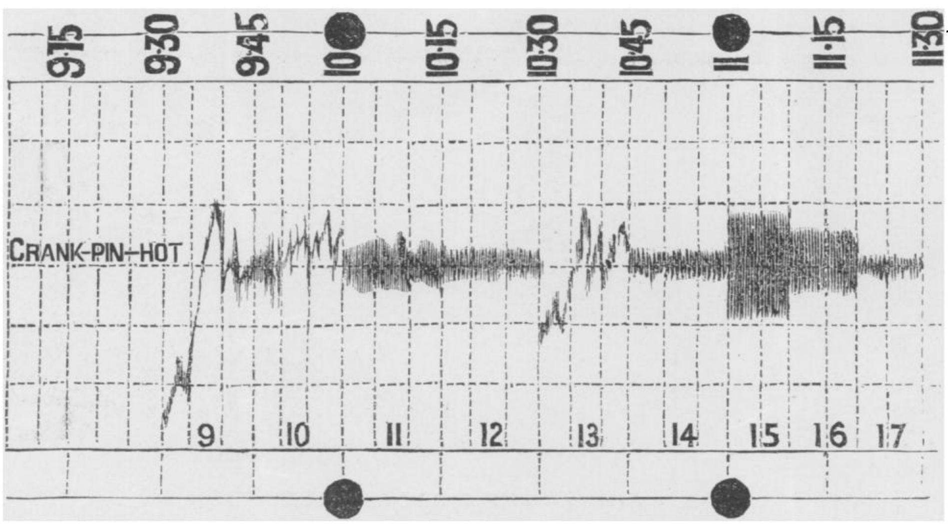


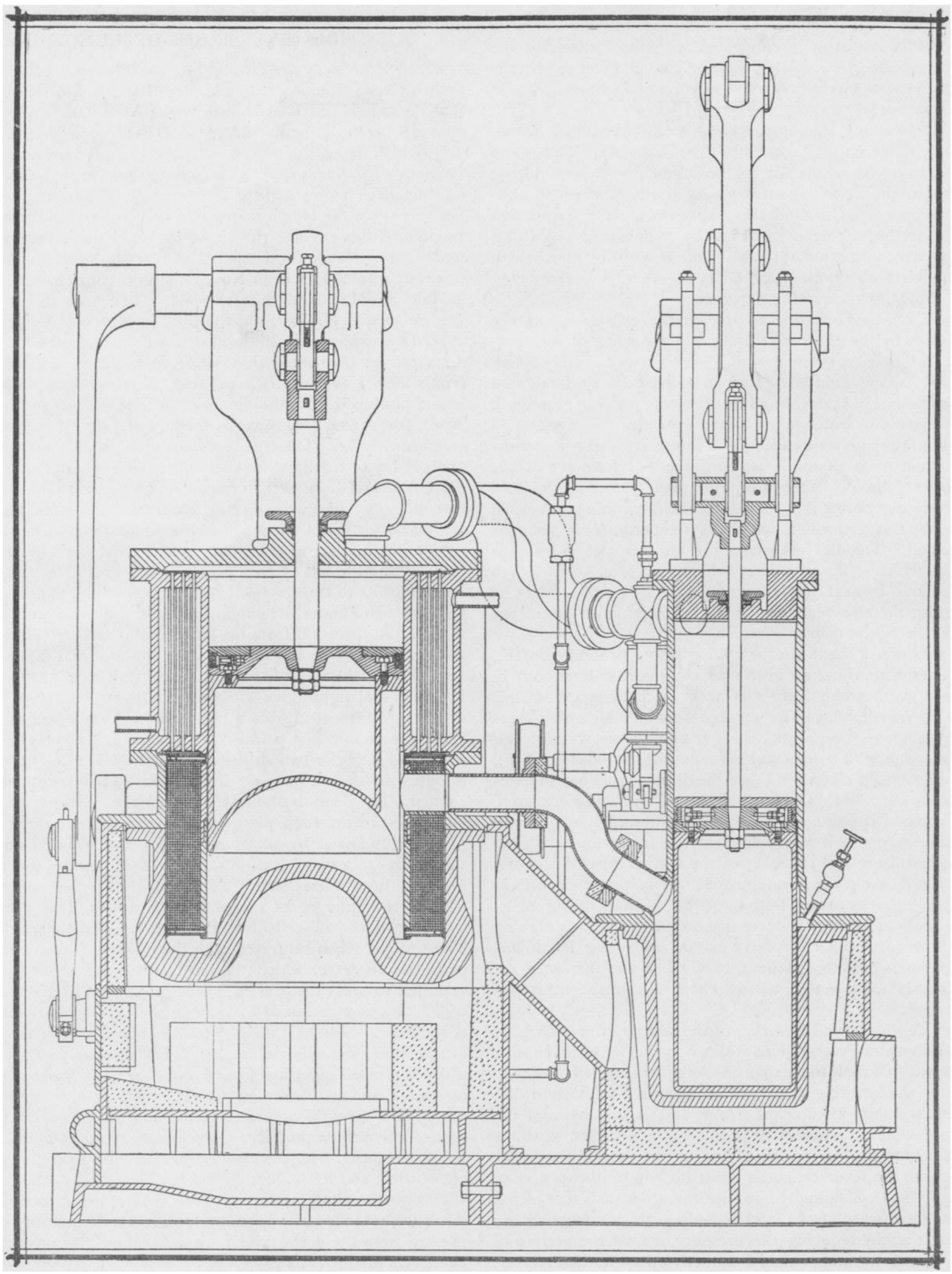
FIG. 4. — MOSCROP RECORDER RECORD.

The Ashcroft Manufacturing Company of this city have exclusive control of the Moscrop recorder for the United States.

A NUMBER of Spanish country teachers have gone to Madrid to make known the wretched condition of most of those to whom the education of the rising generation is intrusted, and to urge upon the government the necessity of including the teachers in the civil servants in the pay of the state.

AN IMPROVED AIR-ENGINE.

DURING the past ten or twelve years the firm of Woodbury, Merrill, Patten, & Woodbury, of Boston, Mass., have been steadily at work developing and perfecting an air-engine; and, as a result of their labors, they are now about to place on the market engines superior in durability and economy to any heretofore constructed. In a test made in South Boston in March last, the quantity of coke consumed was 1.54 pounds per indicated horse-power per hour. A representative of *Science*, on seeing the engine, was surprised at its general excellence and smoothness of movement.



AN IMPROVED AIR-ENGINE.

of their construction in sizes ranging from five to a hundred horse-power. A few experimental engines were built from time to time, as the inventors approached their ideals, and some of those engines are said to have done satisfactory work during a run of five years. But the engines as made at present are claimed to be much

The essential features of this engine are a heater, a regenerator, and a cooler, which three in combination are called a reverser. The engine illustrated is composed of two reversers and two double-acting cylinders, the cut being a section through one reverser and one cylinder. Each reverser is provided with a reverser heater, within a

furnace; a regenerator, composed of wire cloth of great superficial area, extending from the cooler to the bottom of the reverser heater; a cooler, composed of a large number of thin copper tubes, which are surrounded by water; and a displacer piston, having metallic packing rings, and adapted to reciprocate within the cooler. Each working cylinder is provided with a working piston having metallic packing rings. Each reverser is connected by means of pipes with the working cylinders, as follows: the hot chamber below the displacer piston is connected with the bottom of the working cylinder directly opposite, and the cold chamber above the displacer piston is connected with the top of the working cylinder diagonally opposite.

A small single-acting air-pump, having a leather-packed piston, is operated by an eccentric fastened to the main shaft. This pump is used, first, to compress the air to the initial pressure required; second, to maintain the initial pressure so attained, which is subjected to loss by leakage around the piston-rods. The regulation of the speed of the engine is obtained by a balanced equalizing valve of simple construction, placed in an equalizing pipe which connects the top of the working cylinders together, the valve being operated by a common centrifugal governor.

The power produced is due to the energy exerted upon the working pistons by the alternate raising and lowering of the temperature of the same mass of air within the reversers. The cooling medium used is any kind of water, or a blast of air circulated through the coolers. A very small quantity of water is required, and the same body of water may be used over and over again.

In operation, the alternate raising and lowering of the temperature of the same mass of air is accomplished as follows: in the upward stroke of the displacer piston, the mass of air in the cold chamber above the piston is forced through the cooling tubes, in its downward passage through which its temperature is not materially changed. The air then enters the regenerator, in its passage through which it absorbs heat which has been imparted to the regenerator. It next passes over the heated surface of the reverser heater, thereby becoming further heated, and enters the hot chamber below the displacer piston.

The temperature of the air in the cold chamber is about 120° F., and the temperature of the air in the hot chamber is about 600° F.

In the downward stroke of the displacer piston, the mass of air is forced into the regenerator, in its passage through which it deposits therein the greater portion of its heat. It then passes through the cooling tubes, where its temperature is reduced to about 120° F., and then into the cold chamber above the displacer piston. Therefore, at each upward and downward stroke of the displacer piston, the temperature of the same mass of air is alternately raised and lowered. The reversers being in duplicate, it is obvious that the same alternate raising and lowering of the temperature of the displaced air would take place in one reverser as in the other, but at opposite times; that is to say, both displacer pistons being operated by the reverser beam, whenever one displacer piston is making its upward stroke, the other displacer piston is making its downward stroke. It is therefore evident, that, when the displaced air in one reverser is being heated, the displacer air in the other reverser is being cooled.

The alternate raising and lowering of the temperature of the displaced air (in both reversers) generates a power in accordance with the well-known laws of the expansion of gases, which power is developed by the working cylinders, as follows: while one displacer piston is making its upward stroke, and is heating and expanding the displaced air, thereby producing a pressure which is exerted against the bottom of the piston of the working cylinder directly opposite the reverser, and against the top of the piston of the working cylinder diagonally opposite, the other displacer piston is making its downward stroke, and is cooling and contracting the displaced air, thereby reducing the pressure against the bottom of the piston of the working cylinder directly opposite the reverser, and the top of the piston of the working cylinder diagonally opposite. Thus each working piston is subjected to differential pressures, which are alternately reversed as the displaced air is alternately heated and cooled. Thus a power is exerted to cause the working pistons to have a reciprocating motion, which is changed to a rotary motion by means of the working-cylinder beam and its connected parts to the main shaft and the fly-wheel, from which the power may be taken off by a belt. A portion of the power developed is absorbed in the friction of the engine, and a portion is used to operate the displacer pistons. The engine is designed to run on an initial pressure of air of about forty-five pounds, at a speed of 115 revolutions per minute.

PRODUCTION OF ESSENCE OF LEMON IN SICILY.

LEMONS in Sicily are divided into two classes, — the true lemon and the bastard lemon. The United States consul at Messina says that the true lemon is produced by the April and May blooms; the bastard, by the irregular blooms of February, March, June, and July, which depend upon the rainfall or regular irrigation, and the intensity of the heat during the summer and winter seasons. There are but three harvests of the true lemon. The first is the November, cut when the lemon is green in appearance, and not fully ripe. Lemons of this cut are the most highly prized: they possess remarkable qualities for keeping, and are admirably preserved in boxes or warehouses from November until March, and sometimes as late as May, and then shipped. The second cut occurs in December and January, and the third in March and April.

Bastard lemons present well-defined peculiarities in shape and appearance: their inner skin is fine, and adheres tenaciously to the fruit; they are hard, rich in acid, and seedless. The bastard lemon produced from the bloom of June is still green the following April, and ripens only towards the end of July. It remains on the tree over a year. The true lemon can be left on the tree until the end of May or the first week in June; but it interferes with the new crop, drops off from over-maturity, and is liable to be attacked by insects. The bastards, on the contrary, withstand bad weather and parasites, and they mature from June to October.

In obtaining the essence from the lemon, the following operations are performed by the Sicilian workman. He peels the fruit lengthwise with three strokes of a sharp knife, and lets the peel fall into a tub under the chopping-block. He then cuts the lemon in two, and throws it from his knife into a bucket. He works with wonderful rapidity, and fills from ten to twelve tubs with peel a day, and is paid about five cents a tub, weighing 77 pounds. His left hand and right index are protected with bands of osnaburgs or leather. Decayed fruit is not peeled. Fresh peel is soaked in water fifteen minutes before the essence is extracted. Peel that has stood a day or two should remain in soak from thirty to forty minutes, so that it may swell and offer a greater resistance to the sponge. The operative holds a small sponge in his left hand, against which he presses each piece of peel two or three times, — simple pressure followed by rotary pressure. The women employed in this work run a piece of cane through their sponges to enable them to hold them more firmly. The outside of the peel is pressed against the sponge, as the oil-glands are in the epicarp. The crushing of the oil-cells liberates the essence therein contained. The sponge, when saturated with the essence, is squeezed into an earthenware vessel which the operative holds in his lap. He is expected to press the peel so thoroughly as not to overlook a single cell. This is ascertained by holding the pressed peel to the flame of a candle. Should it neither crackle nor diminish the brilliancy of the flame, the cells are empty. This process yields, besides the essence, a small quantity of juice and dregs. The separation of the essence, juice, and dregs soon takes place if the vessels are not disturbed: the oil floats on the juice, and the dregs fall to the bottom. These three products derived from the peel have no affinity with each other. As the essence rises to the surface, it is skimmed off, bottled, and left to settle for a few days. It is then drawn off with a glass siphon into copper cans, which are hermetically sealed. After the essence has been expressed, a small quantity of juice is pressed from the peels, which are then either given as food to oxen and goats or thrown away.

The yield of essence is very variable, and the industry is carried on five months in the year. Immature fruit contains the most oil. From November to April, in the province of Messina, 1,000 lemons yield about 14 ounces of essence and 17 gallons of juice. An operative expresses three baskets of lemon-peel (weighing 190 pounds) a day, and is paid at the rate of about twenty cents a

basket. The essence is so valuable, that the operatives are closely watched. Six men can work up 8,000 lemons a day: two cut off the peel, while four extract the essence, and obtain 136 gallons of lemon-juice and 7 pounds of essence. In the extraction of essence, defective fruit — thorn-picked fruit, blown down by the wind or attacked by rust — is used. This fruit is sold by the "thousand," equivalent to 119 kilograms, and thus classified: (1) mixed lemons as they come from the groves during December and January, of good quality but not always marketable, often from top branches; (2) lemons from March blooms; (3) lemons refused at the packing-houses; (4) dropped fruit; and (5) shrivelled or deformed fruit.

Lemons grown on clay soil yield more essence and juice than those grown on sandy or rocky soil. Dealers sometimes adulterate their essences with fixed oils, alcohol, or turpentine. Adulteration by fixed oils is detected by pouring a few drops of essence on a sheet of paper, and heating it: upon the evaporation of the essence, a greasy spot will remain. Alcohol is detected by pouring a few drops of the essence into a glass tube in which a small quantity of chloride of lime has been dissolved. The tube is then heated and well shaken, and, its contents being allowed to settle, the essence will float on the denser liquid. For the production of raw and concentrated lemon-juice, the following is the system employed. When the lemons have been peeled and cut in two, as described above, they are carried to the press and thrown into large wicker bags, circular in form, and then well pressed. If the juice is to be exported raw, only perfectly sound lemons can be used; but if the juice is to be boiled down, one-fifth of the lemons may be of an inferior quality. The juice from sound lemons is yellowish in color, and has a pleasant aroma: its density decreases with age.

With all classes of lemons the yield of juice and its acidity vary considerably from month to month. The amount of juice increases from October to April, its acidity and density decrease; and the same is the case with the density of the essence, owing to winter rains. An addition of five per cent of alcohol will prevent raw lemon-juice from spoiling. Lemon-juice is adulterated with salt or tartaric acid. Raw and concentrated lemon-juice is exported in casks of 130 gallons capacity. It requires about 1,500 lemons to yield 26 gallons of juice, while it takes 2,500 to yield the same quantity of concentrated juice, and 2,000,000, more or less, according to their acidity, to give a cask. Experience has shown that the lemons of the province of Messina, especially from the eastern shore, contain more acidity than the lemons grown elsewhere in Sicily. The value of lemon-juice is governed by its acidity. The rule is that concentrated lemon-juice shall show 60 degrees of acidity (the juice extracted from the bergamot or the sour orange must show 48 degrees, or one-fifth less than that derived from the lemon; it also sells for one-fifth less than lemon-juice). Formerly a citrometer, known as Rouchetti's gauge, was used to ascertain the percentage of acidity; now, however, resort is had to chemical analysis, which is said to be more satisfactory to both buyer and seller. Of late years a new article, known as vacuum pan concentrated natural juice of the lemon, has been manufactured at Messina. The juice concentrated by this method contains 600 grains of crystallizable citric acid for every quart. It is exported in casks containing 112 gallons, and in half and quarter casks. It is also shipped in bottles of 500, 300, and 150 grains each. Consul Jones says, in conclusion, that there is an establishment at Messina, probably the only one of its kind in Italy, in which crystallized citric acid is prepared. It takes from 340 to 380 lemons to make a pound of citric acid, which sells at about forty-four cents. The quantity of essence of lemon exported from Messina during the year 1887 amounted to 440,000 pounds avoirdupois, valued at $625,000; while of lemon-juice, 4,438 pipes were exported during the twelve months ended Nov. 30, 1887.

ARTIFICIAL SILK.

SCIENCE and industry are ever combining to copy Nature, and even dare to attempt improvements on her processes. The Champ de Mars contains many illustrations of this; but perhaps the boldest and most curious attempt of this kind is to be seen in the manufacture of artificial silk, described in a recent number of *Engineering*. Near the end of the Machinery Hall, that end by the Avenue du Suffren, and quite close to the elevator which raises passengers to the travelling bridges, there is an exhibit showing the manufacture of silk without any aid from silkworms, and on a system which appears to be entirely novel, and is certainly of wonderful simplicity. The silk industry has seen great vicissitudes, and has had to suffer many cruel troubles from disease both of the worms and of the trees they feed upon; but up to the present we believe that it has been spared the struggles of competition. If this new process should prove to be what it promises, a new and dangerous rival to the silk-trade will have to be reckoned with.

The composition of silk may be briefly described as follows: it is a relatively strong, brilliant material, the produce of the digestive juices of the worm acting on the leaves of the mulberry that constitute its food. The cellulose of the leaf is triturated by the worm, and transformed by its special organism into a peculiar substance, transparent, and somewhat resembling horn. This is called kerotine, and it fills two glands, from which it exudes in the form of two threads, which unite as soon as they leave the body of the worm. But this material no longer possesses the chemical composition of cellulose: it is largely combined with a new element characteristic of animal tissues, — nitrogen. The silk-fibre thus discharged forms a continuous thread, which often reaches the great length of 350 metres, the diameter of the fibre being only eighteen thousandths of a millimetre.

It was reserved for the present generation of inventors to devise a means of imitating by science the mechanical and chemical functions of the silkworm.

An old student of the Ecole Polytechnique, M. le Comte de Chardonnet, set himself some time ago to try and solve the problem. He took as his material pure cellulose, — a material, as we have seen, entirely different to that of which natural silk is composed. Cellulose is, as is well known, the basis of vegetable tissues, and particularly of wood. Thus all soft woods appeared to be well adapted for the purpose: in fact, any material suitable for the production of a good quality of paper — white wood, cotton waste, etc. — appeared fitted for the production of artificial silk. Paper pulp is, in fact, the starting-point of the industry. The first operation to which the pulp is subjected is that of nitration, which transforms it into pyroxile. This is done by steeping the pulp in a perfectly defined mixture of sulphuric acid and nitric acid. After thorough washing and drying, the nitrated cellulose is formed into collodion by dissolving it in a mixture of 38 parts of ether and 42 parts of alcohol. The collodion thus made is drawn into fibre by the mechanical means which will be described presently, but the thread requires further and very important preparation. The fibre, as it issues from the apparatus that imitates the glands of the silkworm, is one of the most inflammable of substances, and in that state would be absolutely useless: an absolute process of denitration is therefore a necessity. Of this operation nothing can be said, because it is kept a secret by the inventor. Its object is of course to extract from the filament the greater part of the nitric acid that it contains, and it would be curious to know if the nitrogen that does remain after the process is in the same proportion as that contained in natural silk.

However this may be, the thread after treatment ceases to be inflammable to any marked extent; but it may, if desired, be rendered still less liable to burn. After the denitration process, the filament becomes gelatinous, and other substances can be incorporated with it. Thus, when in this state, it can be impregnated with incombustible material, such as ammonia phosphate; and it is at this stage that the filament can be dyed to any desired color. This latter operation cannot precede the denitration process, as all the color would be taken out during that operation.

The mode of manufacture is very simple, and in the exhibition three apparatus are shown in operation to the public. The first of these is only a model to illustrate the principle. The chief feature consists of a glass tube reduced at the upper end to a capillary passage. It is through this passage that the filament of collodion is forced out under pressure. As it issues, the fibre is in a pasty state, and would have no consistency if it did not consolidate immediately. This solidification is secured by means of a second glass tube, which surrounds the first one, and extends beyond it.

Connected to it is a small pipe which supplies a current of water that bathes the collodion filament, and sets it so that it can be secured by pincers and drawn out without breaking. It is afterwards led to a spool, on which it is wound.

The second apparatus, which is more complete, contains a number of such glass tubes, and illustrates the method by which two or more filaments can be drawn out and twisted so as to form one thread. The third machine is arranged for practical work. The dissolved collodion is contained in a copper receiver having a capacity of about 15 litres. In this receiver it is subjected to a pressure of from 8 to 10 atmospheres that forces the liquid through a horizontal tube, to which are connected 72 capillary tubes, each with their surrounding water-casings. In this manner 72 filaments of artificial silk are produced simultaneously, and these can be spun into threads of various thickness; three such filaments being twisted as a minimum, and ten as a maximum. To effect this, there is placed parallel to the horizontal tube a rack carrying a series of bronze blades that serve to guide the filaments. The twisted threads are wound upon bobbins running on spindles mounted parallel to the horizontal tube. A frame carrying as many pincers as there are capillary tubes can be put in movement by means of a cord, and, if any of the threads are broken, these pincers take hold of the filament and join up the broken parts. This apparatus is enclosed in an hermetically sealed glass case, through which a current of air is continually forced by means of a fan. This air is warmed to assist in drying the filaments; but it becomes cool at the exit, and deposits the vapors of ether and alcohol. The circulating water, which is employed to harden the filaments, is discharged into a receiver. It contains a large percentage of the volatile products, which can be recovered by distillation, and in this way only about 20 per cent of the ether and 10 per cent of the alcohol are lost. One tube can produce from 3 to 5 pennyweight of filaments per hour, or a length of nearly $1\frac{3}{4}$ miles. The apparatus works continuously, and with but little attention; and, if by any chance one of the capillary openings becomes sealed, it can be cleared by applying heat.

Under the conditions in which the machine is exhibited at work, the artificial silk can be sold at from 15 francs to 20 francs the kilogram, while real silk costs from 45 francs to 120 francs the kilogram. The manufactured product resembles very closely the natural one. It is smooth and brilliant, and the filament has a strength about two-thirds that of silk. Woven into a tissue, it appears stronger and less liable to cut, this property being due to the fact that it is not charged with destructive materials, which appear to be always used in dying silk, such as zinc or lead. These foreign matters are probably introduced solely for the purpose of weighting the silk; but there is no object for similar adulteration of the artificial product, because the metallic preparations employed cost as much as the collodion thread. According to M. de Chardonnet, the density of his product lies between that of raw and finished silk. Its resistance to a tensile strain varies from 15 tons to 22 tons per square inch (copper breaks under a load of about 18 tons, and iron under 23 tons). The elasticity is about the same as that of natural silk, and the inventor claims that it has a superior brilliancy. M. de Chardonnet exhibits a number of stuffs woven wholly with the artificial silk, as well as others mixed with natural silk and other textile materials. The results are really very remarkable. Among other objects, he shows a chasuble of artificial silk which will bear very close examination.

Artificial silk is not yet manufactured on an industrial scale, but it appears that this will very shortly be done; and, while it is impossible to foretell with certainty what will be the commercial results of this curious invention, it is impossible to resist the conclusion that it is highly practicable, and that it even contains the elements of great future success.

TENTH CONVENTION OF THE NATIONAL ECECTRIC-LIGHT ASSOCIATION.

THE tenth convention of the National Electric-Light Association was held at Niagara Falls, N.Y., on Tuesday, Wednesday, and Thursday, Aug. 6, 7, and 8, the sessions being held in the Casino. The convention was called to order on Tuesday morning by Mr. E. R. Weeks of Kansas City, president of the association, who, in his opening address, briefly outlined the objects of the meeting, and gave a synopsis of the progress made in the electric-light industry since the preceding convention. The address concluded with the statement that statistics of the association show that the number of arc lamps in service in the United States alone during the last six months has increased from 219,924 to 237,017; that of incandescent lamps, from 2,504,490 to 2,704,768; and that the number of street-railroads operated by electricity is now 109, comprising 575 miles of track and 936 motor-cars. The capital invested in these industries at present amounts to $275,000,000.

At the conclusion of his address the president introduced the Hon. W. C. Ely of Niagara Falls, who delivered the address of welcome. In his address Mr. Ely touched upon the much-talked-of project of utilizing Niagara Falls as a motive power for the generation of electricity on a grand scale, quoting Sir William Thomson's statement that Niagara Falls possesses more power than all the coal-mines in the world, and Edison's remark that Niagara is the greatest storage-battery in the world. "This latter," Mr. Ely added, "is absolutely truthful, and, with the power of the waterfall developed by means of an hydraulic tunnel, a system of powerful dynamos to transform the water-power into electricity, and this transmitted to Buffalo, that city might be supplied with light and power far more cheaply than at present, and a demonstration of the capabilities of electrical power and transmission afforded that would give us something more sure than the world has as yet had."

After Mr. Ely's address, the secretary read a letter from the mayor of this city to the president of the association, Mr. Weeks, requesting his presence at a "conference of representative citizens to consider the advisability of holding an international exposition at New York in 1892, and to arrange for the preliminary work if it is deemed advisable." This letter was responded to by the appointment of a committee of five, whose chairman is to represent the association in any manner desired by the mayor. The members of the committee are, Dr. Otto A. Moses of New York, chairman; E. T. Lynch, jun., of New York; C. J. Field of Brooklyn; Fred A. Gilbert of Boston; and J. P. Morrison of Baltimore.

The report of the committee on the revision of the constitution and by-laws was then received, printed copies of the proposed constitution ordered distributed among the members, and its discussion made a special business for the Thursday morning session. The committee on underground conduits and conductors, being called upon for its report, asked for an extension of time until the next annual convention, which was granted. Mr. E. A. Foote then read a paper on "The Value of Economic Data to the Electric Industry," which was discussed by Messrs. Morrison, Morris, De Camp, Coggeshall, and Whipple; and a resolution based upon the paper was adopted, to the effect that a committee of five be appointed by the president to report at the next convention of the association forms and a system of records and accounts to be kept by central station companies, a system for reporting the same to the association, and for comparing and publishing the data so secured, for the use and benefit of the members of the association.

Mr. M. D. Law then read a paper entitled "The Perfect Arc Central Station," treating of boiler-rooms and boilers, engines, shafting, dynamos, switch-board, lines, store-room, and shop. This paper was discussed by Messrs. Morrison, Law, Smith, Leonard, and De Camp. At the close of the session the president announced the following committee on electrical statistics: A. R. Foote, chairman; A. J. De Camp, S. A. Duncan, E. F. Peck, and S. S. Leonard, assistants.

At the Wednesday forenoon session the secretary and treasurer presented their report, showing a present membership of 251, an increase of 55 per cent over last year. The annual income of the association is at present $5,050, and the expenses for the past six months were $2,241.80. The report of the committee on harmonizing electrical and insurance interests was then received and adopted, and the committee continued, with instructions to take under advisement the feasibility of establishing a mutual insurance company. A committee was also appointed to prepare a petition for the abolition of import duties on copper. At the afternoon session a paper was read by Mr. F. A. Wyman, on "The Constitu-

tionality of Execution by Electricity," and was discussed by several of the members, after which it was resolved that the association petition the General Assembly of the State of New York to repeal the electrical execution law at its next session. A paper by Mr. William Bracken, on "Electric Traction by Storage-Batteries," was then read by Mr. S. M. Young, after which J. F. Morrison, E. T. Lynch, jun., C. C. Martin, E. F. Peck, and A. J. De Camp were appointed a committee to nominate the executive committee, and to choose a place for the next convention.

At the Thursday morning session, after the report of the committee on legislation, Mr. C. C. Haskins read a paper on "Dynamo Room Accessories for Intensity, Potential, and Resistance Measurements." Dr. Moses then read the proposed new constitution, which was accepted, after which Mr. G. W. Mansfield read a paper on "Electric Railways," and Professor E. P. Roberts read one on "The Electrical Transmission of Power." The report of the committee on executive committee and place of next convention was then received and adopted, Kansas City being the place selected, and the executive committee being as follows: G. W. Hart, chairman; L. A. Beebe; J. A. Corby; B. E. Sunny; S. S. Leonard; C. R. Faben; P. H. Alexander; Frank Ridlon; and J. F. Morrison. The convention then adjourned.

HEALTH MATTERS.

Disinfection of Springs, and Number of Germs in Ground-Water.

DR. CARL FRANKEL, in the *Zeitschrift f. Hygiene*, reports a series of experiments made by him to determine some points of practical importance; namely, what are the relative values of tube-wells and pot-wells, and can they be disinfected by the measure usually recommended?

With regard to tube-wells, from their mode of construction they are not liable to contamination from surface impurities, as the pot-wells are, and it becomes of the greatest consequence to know whether they receive infective micro-organisms from more distant sources. The result of these experiments is, that as a rule the water entering tube-wells is absolutely free from micro-organisms. But it still appears that a growth of micro-organisms takes place in the tube-wells, and a consideration of all the circumstances points to the growth of a pellicle of micro-organisms clinging to the sides of the tube. Hence one way of disinfecting the tube-wells is to brush them clear, and then completely pump off the turbid liquid. In cases where this proceeding proves inadequate, a concentrated solution of carbolic acid and sulphuric acid dropped into the tube, and left for a day or two, will complete the disinfection. Disinfection of these wells by lime is quite unsuitable, as it forms a mortar, and seriously interferes with the entrance of water.

The ordinary pot-well, on the other hand, is incapable of disinfection, and Dr. Fränkel agrees with Plagge that it is a hygienic monstrosity. Considering how common pot-wells are in our country districts, these are results which require careful attention.

The tube-wells, which Dr. Fränkel found to furnish water freer from germs, were sunk in a part of Berlin which, at first sight, would seem to expose them to great risk of infection. In reality, however, after a time a thick pellicle forms in old soils, which effectually precludes the passage of germs beyond a certain depth. Two sources of error have here to be guarded against. In the first place, the pellicle or its equivalent, which prevents the passage of germs downward, may be broken through at some point, or the corresponding ground may be constituted in parts of pebbles or gravel, which allows of the transmission of micro-organisms; and, in the second place, the chemical constitution of the water passing away from these old soils will very likely be such as to lead to a free growth of micro-organisms, as was the case in these experiments. It is practically impossible to exclude all access of micro-organisms to the well.

The chief conclusions to be drawn from Dr. Fränkel's experiments are, that Abyssinian or tube-wells are infinitely preferable to the ordinary pot-well, and that a disinfection of the tube in the manner indicated above is, as a rule, all that is necessary to make the water quite free from micro-organisms.

PHTHISIS IN ARMIES. — According to Dr. R. Schmidt of Munich, who has collected a mass of material connected with the statistics of phthisis, the number of soldiers who suffer from phthisis in the German army (excluding Saxony and Bavaria) is, says the London *Lancet*, 3 per 1,000; and the number of deaths from this cause, 0.9 per 1,000. In the Austrian army the numbers per 1,000 are 6.4 and 2.2 respectively; in the Italian army, 4.3 and 2.9. In the Russian and French armies, only the number of fatal cases is given, which is 12.5 per 1,000 in the former, and 2.2 per 1,000 in the latter case. In the English army, which on account of long service and foreign service is not to be compared with continental armies, the number of cases per 1,000 is 11.8, and the number of deaths 6.2. At first sight, one would expect, that, as only men who are found on examination to be healthy are taken as recruits, the number of cases of phthisis ought to be very low. As a matter of fact, however, it is, in Bavaria at least, higher than among civilians of similar age and sex. The reason of this remarkable circumstance is discussed in an article in the *Koenigsberger Zeitung*. How important a factor direct contagion is, the experiments of Cornet show, as well as the fact that hospital attendants fall easy victims to the disease; but Dr. Schmidt believes that the most frequent explanation is that recruits come into the army with a latent tendency to phthisis, and that the conditions under which they are then suddenly placed cause a more or less rapid development of the disease. The knapsack, for instance, appears to have a decidedly prejudicial effect, as is shown by the fact that those regiments which do not wear it present a lower phthisis mortality than those in which it is worn. Again, the diet and the whole regimen of the soldier are, according to Dr. Schmidt, calculated to lessen the power of resistance to the development of phthisis: consequently it is not to be wondered at that a larger proportion of soldiers than of civilians develop it.

A GOOD WORD FOR THE GYPSIES. — There is so great a prejudice against this race, that it is with pleasure that we record testimony in favor of what is claimed to be one of their good points. Every one is familiar with the dusty and dishevelled condition of the modern tramp; but it is claimed by Mr. E. L. Wakeman, in an article in the *Annals of Hygiene* for May, 1889, that the gypsies cannot be accused of uncleanliness. He has made a close study of the race in many lands for more than a quarter of a century, and says that he has never known a physically unclean gypsy, the only exceptions being a few individuals in the towns of southern Hungary and in Havana. The gypsy-camps are always pitched near a brook or stream, and the morning bath is as certain as the morning itself. The cleansing is not of the skin alone; but the garments are constantly washed, and the straw bedding is likewise daily spread out for a sunning and airing.

THE UTILIZATION OF GARBAGE. — According to the *Bulletin of the Rhode Island State Board of Health* for May, the city of Milwaukee will soon abandon the cremation of garbage, which it was among the first of the Western cities to adopt and advocate. It is proposed to substitute a dry process in the place of combustion. A company is at work with a new method which converts cities' refuse into articles more or less salable. The garbage is made to pass through a series of mechanical driers, and in the course of ten hours becomes a brown powder. The oil is pressed out or drawn off, and the residue can be sold as a fertilizer.

CREMATION IN FRANCE. — The Municipal Council of Paris has appropriated 383,299 francs for the erection of a crematory in that city, and has levied a "cremation tax" to defray the expenses of the incineration of the bodies of those whose friends cannot afford to pay for it.

PASTEUR INSTITUTES. — According to the Rome correspondent of the London *Daily News*, the Municipal Council of Rome has decided to devote a sum of money to the formation of a Pasteur institute. Confidence in M. Pasteur's treatment of hydrophobia is increasing in Italy, as is shown by the fact that little by little all the principal towns are providing buildings for the treatment of the disease by inoculation.

NOTES AND NEWS.

THE eighth congress of Russian naturalists will be opened at St. Petersburg on Jan. 7, 1890, and will last a week.

— We regret to have to announce the death of the Rev. J. M. Berkeley, the eminent cryptogamic botanist.

— Mr. Henry Shaw, the founder of the celebrated botanical gardens in St. Louis, has just celebrated his eighty-ninth birthday.

— We learn from *Nature* that the professorship of civil engineering and mechanics in the University of Glasgow is likely to be vacant by the resignation of Professor James Thomson, on account of weak health.

— Actual elevations taken since the recent disaster at Johnstown, Penn., show that during the flood the water in the neighborhood of Conemaugh and the South Fork bridge reached an average height of forty feet above low-water mark. At the big viaduct on the up-stream side the water was seventy-nine feet deep.

— The Russians have recently improved on the sleeping-coaches of the railway and the perambulating schoolmaster of the rural regions. They have provided a school-wagon which is furnished with a room for the teacher, a classroom or study, and a library, all suitably supplied with the necessary material. This wagon will be on the line of the Transcaspian Railway all round the year, remaining as long as may be deemed necessary at districts which are not provided with a school.

— The Imperial University of Tokio, in Japan, is making rapid progress. The number of professors and teachers amounts this year to 138, of whom only 16 are foreigners, the rest being Japanese. The attendance of students has risen to 788. New buildings for technical education, and a new chemical laboratory, have been erected at the cost of nearly $300,000, and more money is promised by the government for further extensions.

— It is stated that the Electro-Automatic Transit Company, whose railway system was described in *Science* of July 12, has succeeded in running its experimental car at the rate of 120 miles an hour for a distance of ten miles. The experiment was performed at the company's two-mile circular track at Laurel, Md. The company intends to construct a five-mile experimental road in the neighborhood of this city, upon which to test the applicability of their system to passenger service, only light packages and mail matter having been experimented with heretofore.

— The eleventh congress of the Sanitary Institute, which is to meet at Worcester, Eng., from Sept. 24 to 28, will be divided into three sections: viz., Section I. Sanitary Science and Preventive Medicine; Section II. Engineering and Architecture; Section III. Chemistry, Meteorology, and Geology. Each section will begin its work on a separate day. A conference of medical officers of health will be held during the congress; and there will be a health exhibition in the skating-rink and special additional buildings from Sept. 24 to Oct. 19. This exhibition will include sanitary apparatus and appliances, and articles for domestic use and economy.

— "Now, children," said a teacher, after reading the old story of Washington's exploit with his hatchet, "write me all you can remember of that pretty story I have just read to you." The following was the result: Slate I. (Teddy, 8 years old). "George Washington is our father did he tell a lie no he never did he did with a hatchit;" Slate II. (Ethel, 7). "george washington was the father of is countre hes father sed did you do it he sed i wud not lie i did it with my Hathit and then he busted in tears;" Slate III. (Georgie, 9). "George Washington is the father of our country and he did it with his hatchit and he sed father I did it did the boy deny it o no did he try to put it on some other feller No He did not tell no lie he burst into tears."

— It is generally supposed that oak is much stronger than fir, but a series of tests made recently at the car-shops of the Northern Pacific Railroad, in Tacoma, show that the reverse is actually the case. The tests were made by actual breaking strain, on sticks two by four inches, and four feet long, the weight being applied in the middle of a span of three feet nine inches. The results of five tests were as follows: first, an old piece of yellow fir, six years exposed to the weather, broke at 3,062 pounds; second, a new soft piece of fine-grain yellow fir broke at 3,062 pounds; third, old piece of yellow fir, coarse grain and hard, broke short at 4,320 pounds; fourth, a new piece of fir from the but of a tree, coarse grain, broke with a stringy fracture at 3,635 pounds; fifth, a new piece of Michigan oak broke nearly short off at a weight of 2,428 pounds. The deflections before breaking were as follows: the first and second pieces, half an inch; third, three-eighths of an inch; fourth, five-eighths of an inch; fifth, the oak piece, one-inch and an eighth.

— The three teaching universities of Australia — Melbourne, Sydney, and Adelaide — all admit women to their lectures and degrees. It appears that there are now thirty-nine women studying in Melbourne University, twenty-three in Sydney, and thirty-four in Adelaide, the latter figures not including a number of students who are not qualifying for degrees. Adelaide first admitted women students in 1876; Melbourne and Sydney, in 1881 and 1882. Ten ladies have graduated in Melbourne, nine in Sydney, and only two in Adelaide. In all three universities, all prizes, scholarships, and university privileges generally are open to women, who are also eligible as lecturers and professors. In Melbourne they are debarred from membership of the senate, but this seems to be the only barrier of any kind placed in their way.

— In connection with the recent heavy rainfall in the neighborhood of New York, it is interesting to note that at a meeting of the Royal Society of New South Wales, June 5, in the course of some remarks respecting the recent heavy rainfall, Mr. Russell (the government astronomer) stated that he had no hesitation in saying that if rain equal to that which fell in and around Sydney (i.e., 20 to 26 inches) had fallen generally over the catchment areas of Windsor, Richmond, the upper parts of the Hawkesbury, and in the valley of the Hunter, most if not all of the towns on their banks would have been swept away.

— In a recent work by Professor Hartig it is stated, says *Garden and Forest*, that a count of the annual rings of a tree when cut three or four feet from the ground may not give the accurate age of the tree. Where trees are crowded in a forest, and have developed feeble crowns, the greatest annual increment is just below the crown, and it diminishes regularly downwards. When the leaf-area is not sufficient to afford food-material to provide for a sheet of cambium all over the tree, the growth stops before reaching the bottom, and the ring which is found twenty feet up the trunk may fail altogether before it reaches the ground. In such trees there may be rings lacking at three feet high for certain years, and the total number of rings would be less than the number of years in the tree's life.

— The Newfoundland bait act, prohibiting the export of fish-bait from that island, instead of having a prejudicial effect upon the French bank fisheries, as was expected, may have the opposite effect. According to the Montreal *Witness*, the French fishermen have discovered, through necessity, the fact that on the fishing-banks they can catch unlimited quantities of large periwinkles, which, when removed from the shell, and used as bait on their trawls, are a bait which codfish take most ravenously. It thus becomes possible for the fishing-smacks to remain on the banks till their take is complete, hauling up bait on one side of the vessel, and cod on the other, instead of running in to port at intervals, and paying an exorbitant price for bait.

— At a meeting of the London Chemical Society, June 20, as reported in *Nature*, a note on a yellow pigment in butterflies was read by Mr. F. G. Hopkins. The color effects on the wings of lepidopterous insects are for the most part probably due to purely physical causes, but in some cases pigments are undoubtedly present. A yellow pigment, which is found in its purest form in the common English brimstone butterfly, and may also be detected in the wings of a very large number of day-flying *Lepidoptera*, can be obtained from the wings by simple treatment with hot water, in which it is freely soluble, and may be identified by its yielding a

marked murexide re-action, when evaporated with nitric acid, and afterwards treated with ammonia or potash. The common brimstone butterfly yields somewhat less than a milligram of pigment from each insect: larger foreign species, such as those belonging to the species *Callidryas*, may yield as much as four or five milligrams. Examination of the pigment reveals its near relationship to mycomelic acid, a yellow derivative of uric acid; and the author suggests that it may possibly be a condensation product of uric and mycomelic acids.

— The International College, Spring Grove, not far from London, England, which twenty-five years ago was much talked about and seemed to be full of promise, ceases to exist at the end of this month. The college was brought into existence through a suggestion of the late Richard Cobden, made soon after the French treaty of commerce was concluded in 1860. The intention of the promoters, as given in *The Educational Times*, was to found three proprietary colleges, — one in England, one in France, and a third in Germany, — which should follow the same curriculum, so that students could spend part of their time in each of the colleges, the change of residence being effected without any break of continuity in their studies. There was probably involved in the notion a dream that the international intimacies which such a system would necessarily bring about would tend to put an end to wars and rumors of wars. Indeed, we find it suggested in one of the earlier prospectuses of the college, that, "if the boys of these nations were taught each other's languages in these colleges, when they became men the connection would be made still closer; and it was hoped, that, if this principle were extended to other nations, it might in time have the effect of lessening the number of wars." The Continental members of the triangle were never fairly started, but Mr. Cobden and his friends succeeded in establishing the English college.

— It is claimed that in the new Bookwalter process for converting crude metal into malleable iron or steel, the air-blasts are brought into contact with every portion of the metal, thereby securing a uniformity of structure throughout the entire mass, which has not always been secured with other processes. The main portion of the process is thus outlined by its inventor, Mr. J. W. Bookwalter of Springfield, O.: "Having ascertained that the tendency to form local currents or vortices is much greater when the air-blasts enter the metal near the surface than when they enter at a greater depth below the surface, I devised means whereby to secure a continuously uniform action of the air upon limited uniform quantities of the metal at one time, feeding the metal gradually to the air within a fixed or limited space. By this means small portions of the metal as they are fed to the air are driven thereby out of the zone of violent agitation of the air and metal, and thereafter are thrown back toward the greater body of metal while a new portion of the latter is being brought under the influence of the air, that portion of the metal which is submitted to the action of the air being the purest portion of the body, — that is, having combined with it less scoria than any other portion, — and the greater body of the metal which is not under the direct influence of the air being comparatively stationary, and free from currents or vortices."

— In a letter to *Nature* under date of Cambridge, Mass., July 15, Dr. H. A. Hagen writes, "Having studied Sir J. Lubbock's interesting book, I remembered a fact observed by me, which, though it is not conclusive, seems worth mentioning. I was amused some years ago to observe the feeding of the young in a sparrow-house near an upper window of my house. The old sparrow alighted upon the small veranda of the sparrow-house with four living canker-worms in his beak. Then the four young ones put out their heads with the customary noise, and were fed each with a caterpillar. The sparrow went off, and returned after a while again with four living canker-worms in his beak, which were disposed of in the same manner. I was so interested and pleased with the process that I watched it for some time and during the following days. A fact which I have not seen noticed here in the extensive sparrow literature, is that for a number of years sparrows begin to build nests of dry grass and hay at the top of high trees. The first I saw were large irreuglar balls placed on the tripod of twigs. The entrance was on the inner side near the lower end of the balls. Last year I observed another form of the nests. A strong rope formed of dry grass, as thick as a man's wrist and as long as the fore-arm, is fastened only with the upper end to strong branches at the top of high trees. The rope's end has a rather large ovoid shape, with the entrance to the inside near the end. Of such nests I saw last winter about a dozen on the elms here in Main Street, near the college grounds, and similar ones in Putnam Avenue and other streets. A long pole near my house strongly covered by a vine (*Celastrus scandens*) had such a nest for three years, used every year. In the sparrow-houses around my lodging the sparrows stay throughout the winter, commonly one male and three females in every house, till in spring the superfluous females are turned out."

— At the thermometric bureau of the Yale College Observatory during the last year the comparison of thermometers has continued to be made by Mr. C. B. Peck. The number received for verification during the year ending June 1, 1889, was 7,475, being 249 in excess of the preceding, the maximum year. It is perhaps well to call public attention to the fact, not new, but continually overlooked, that the most accurate thermometers may be made to give false testimony by misinterpretation of their language. Although every certificate issued from this observatory, for other than clinical thermometers, contains a statement of the only conditions under which the correction therein given can be truthfully applied, they are continually called upon to explain, especially in the case of high-temperature thermometers, that, when only the bulb is immersed in a liquid of high temperature, the indicated temperature is too low by an amount depending upon the number of degrees of the mercury in the cooler stem and the difference between the temperatures of the bulb and stem. They have been called upon to show frequently that this error, which is independent of any correction due to the thermometer, may be as much as eight or nine degrees in the case of high-temperature oils, as their temperatures are generally measured. A simple remedy for this indefiniteness of measurement would seem to be a special form of thermometer in which nearly all the mercury should be immersed. Of the same nature is the correction of possibly 0°.1 to be applied to clinical thermometers of the "Indestructible Index" form, when the detached column of mercury constituting the index is quite long (expressed in degrees), and is read after removal to a much cooler atmosphere; but the probable error on this account does not exceed the probable error of reading.

— Recent reports to the United States Hydrographic Office regarding the seeming failure of certain fog-signals render it desirable to give the conclusions of an expert in this subject. We extract the following from a paper read before the Philosophical Society of Washington, October, 1881, by Mr. Arnold B. Johnson, chief clerk of the Lighthouse Board: "When approaching from windward, the fog-signal is picked up earliest aloft; from leeward, on deck. Do not assume that you are out of hearing distance because you fail to hear the signal, nor that you are at a great distance because the sound is faint, nor that you are near because you hear it plainly. Do not assume that you have or have not reached a given point in your course because you do or do not hear the signal with the same intensity as on some former occasion. Do not assume that the signal has ceased sounding because you fail to hear it even when within easy earshot. Do not assume that the aberrations of audibility are the same in different fog-signals. Do not expect to hear the signals as well as usual when the upper and lower air-currents run in different directions, or when wind and tide do so, or during a time of electric disturbance, or when the sound must reach you from over an island or point of land. When there is a bluff behind the signal, be prepared for irregular intervals in audition, as would follow were the sound to ricochet like a cannon-ball. Thus you might hear it at 2, 4, 6, 8, etc., miles, and lose it at 1, 3, 5, 7, etc., miles, or at any other combination of distances, regular or irregular. Until the laws governing these aberrations are evolved and a method is discovered by which the irregularities can be corrected, you will do well, when you do not get the expected sound of a signal, to assume that you may not hear the warning that is nevertheless faithfully sounded, heave your lead, and use other means to make sure of your position."

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CONTENTS:

THE APPOINTMENTS BY THE MAYOR to the committee of one hundred on the world's fair of 1892 in New York give very general satisfaction. Fifty-seven industries are represented, and in addition the mayor has named forty-three substantial citizens to fill out the number. Among those specially representing industries, we note, for artists and art collectors, Henry G. Marquand; architects, Richard M. Hunt; banks and bankers, Levi P. Morton; clocks and watches, Daniel F. Appleton; mechanical engineers, Henry R. Towne; civil engineers, John Bogart; periodicals and publishers, John Foord; printing, J. J. Little; railroads, Chauncey M. Depew; scientific and educational interests, Charles F. Chandler. The members of the committee of one hundred have been duly apportioned among the four committees on permanent organization, finance, legislation, and site and buildings. As many of the members of these committees are out of town, no meeting will be held this week. On Tuesday of next week, however, at 3.30 P.M., the committee on finance will meet in the governor's room in the City Hall; and on the following Thursday, at the same hour and place, the committee on site and buildings. The other two committees will not be called upon to act until these two have met. After a site has been selected, the committee on legislation will prepare a bill to be presented to the Legislature.

There is naturally some desire on the part of the smaller cities, more especially Chicago, that the exhibition, or some part of it, should be held within their limits; Boston, for instance, asking only a branch show specially devoted to New England. There is no likelihood of any splitting of the show into local exhibitions, and the site for the whole will depend, except in so far as political influences may warp things, on the commercial interests at stake. As the time has come when world's fairs pay their expenses if skilfully managed, there is no longer need of a call for any sacrifice on the part of those who will pledge themselves for the expenses. This needed guaranty of funds can be secured in this city just as soon as it shall appear wise to ask it; the question now agitating those having the financial matters in charge being as to how far the money shall be raised by popular subscription to bonds of small denomination, the better to enlist popular interest. If any city except Washington should ask for government aid, it is to be supposed that this of itself would rule that city out of the race, the winner in which will be decided by Congress.

Washington not being a commercial city, it seems undesirable that the exhibition should be held there, especially as there are lacking the facilities for handling the large shipments of goods and the number of visitors. At the same time, the hotels of Washington are of low grade, and entirely unequal to the demands of a world's fair. Then, again, the weather in Washington is likely to be much more oppressive in summer than in New York. The great objection to New York that has been brought forward so far is the lack of local pride. This lack, as is well pointed out in *The Evening Post*, is due to the fact that New York is *facile princeps* among American cities: it is only the little man and the little town that have to boast continually of such good as they may possess, in order that they may not be ignored, and that have to strive constantly to make their good points the better. New York certainly lacks this spur; but she is made up of shrewd business-men, who are amply able to carry through a world's fair just as soon as they have decided that their interests demand it.

THE UNITED STATES, THEIR GROWTH IN POPULATION IN TWO HUNDRED YEARS.

IN 1798, eight years after the first census of the United States was taken, Malthus, in England, published his "Treatise on the Law of Population," which excited great interest, and brought the author much hostile criticism. In June, 1890, we shall take the eleventh census of the United States, and will know with certainty what has been our increase in a hundred years. We expect to find a population of 67,240,000. Malthus held that population in a wide country, affording plenty of space and producing abundant food, doubled every twenty-five years. Trying his estimate by the recorded figures of ten decennial census enumerations, we find that he was very nearly correct.

With the aid of this information, we attempt to discuss the results to date, and to infer something of the progress of the next hundred years. We do not think it rash to infer the work of a century from the known advance during one just expiring. Taking the figures of the past from "Johnson's Cyclopædia," we find the population of the North American Colonies estimated by Bancroft as follows: —

Year.	Population.
1750	1,260,000
1754	1,425,000
1760	2,195,000
1770	2,312,000
1780	2,945,000

The following table shows the rate of increase since 1790, as shown by the census returns: —

Year.	Population.	Increase in 10 Years.
1790	3,929,214	
1800	5,308,483	35.1 %
1810	7,239,881	36.3
1820	9,633,822	33.1
1830	12,866,020	33.5
1840	17,069,453	32.6
1850	23,191,876	35.8
1860	31,443.321	35.6
1870	38,558,371	22.6
1880	50,175,000	36.0
1890	67,240,000	34.0

The mean of the rates is 33.46 per cent. If we substitute for 22.6 (the exceptional rate of the increase between 1860 and 1870) 34.8 per cent (a mean between the rates immediately preceding and following the decennial epoch), we find as probable rates of increase and aggregates of population, had peace continued, the following: —

Year.	Population.
1870	42,380,000
1880	57,130,000
1890	77,100,000

This is 9,860,000 more than the population actually to be expected in the next census, — loss to be attributed to a great war. Other variations in the decennial rate of increase are due to the war of 1812, the Mexican war, the cholera epidemics, etc., and to emigration.

In estimating the progress of population during another century, it is not perhaps rash to assume a rate of 33.3 per cent, which is a little less than the mean rate, including war and pestilence, which has ruled our growth in the last century. Adding one-third to each decennial estimate, we find the probable population to be as follows: —

Year.	Population.
1890	67,240,000
1900	89,653,333
1910	119,737,777
1920	159,650,377
1930	212,867,177
1940	283,822,877
1950	381,763,837
1960	509,018,449
1970	678,691,265
1980	904,921,686
1990	1,206,562,248

This completes the century. Then, as the area of the territory of the United States is 3,026,494 square miles, the density of its population in 1990 will be 399 to the square mile. The density of population in certain countries is given in the same cyclopædia (printed in 1878) as follows: United States, 12.7 per square mile; Atlantic States, 46.6; basin of the Ohio, 37.7; Massachusetts, 201; Ohio, 66; Belgium, 434; China, 420; England, 389; Europe, 71; Asia, 46; Africa, 16; America, 6; Australia, ½. Such a nation will have a power and a commerce and industry not heretofore known to the world. Our ships and those of our allies will bring the spare products of every land to our shores. Systems of interior land and water transport, perhaps mostly operated by electric power, will rapidly and cheaply distribute them.

For a century we may hope to live comfortably and abundantly within our boundaries. But other people must grow also. The now empty and waste places of the earth will be occupied by civilized and industrious nations. We have in this generation made wonderful and rapid progress in the discoveries and inventions of science. We use the electric force, as did our fathers that of steam. In all probability, electricity will heat as well as light our houses, and will cook our food, It will drive other as well as our city passenger railroads. And it is not probable that man has yet discovered all the resources laid up by the Creator to be discovered and utilized by his creatures when needed for their happiness and comfort.

The Anglo-Saxon race will occupy the continent from the Isthmus to the Arctic, and, when crowded therein, must spread over South America, or perish. That they are not likely to submit to As the prairie wolf disappears when man drives off or subjugates the animals on which he lives, and for whose regulation he appears to have been created, so will the weaker races give way to the stronger. It has been thus in all history, and the law still holds. There are in the United States a majority of whites over blacks of 51,000,000. They will be able to settle without bloodshed most of the apparently troublesome questions as to races, as may to them seem best; and when they agree upon the methods, and necessity enforces the duty, they will settle them for the best good of the greatest number.

Soon after the civil war it was often said that they who believed in the success of the United States, and conducted their affairs on the theory of such success, grew rich and prospered. They who took the opposite belief were unsuccessful, and lost their fortunes. Those who believe in the prospects here set forth will rule their undertakings and investments in the expectation that property in real estate must advance in the next half-century; that commerce and transportation and production must increase enormously. As the discoveries and inventions of science and industry make towns more and more healthful, convenient, interesting, and agreeable places of residence, our people will tend more and more toward them. Museums, libraries, public halls for the education and instruction and amusement of the people, will be more and more numerous and cheap. The streets and parks will be embellished and made gay with public and private buildings. Electric engines will do the heavy work of the day. More time will be at the disposal of men for enjoyment, as these improvements relieve men and women from slavish toil for the means of living.

It may be assumed that the cities will grow at least as fast as the country. In 1790 the urban population was estimated at one-thirtieth the whole; in 1840, at one-twelfth; and in 1870, at one-fifth. In 1990 the urban population will be 240,000,000; and of these, New York will probably contain over 30,000,000. What will be the value of lands in that city then, may be inferred from the auction-sales of London, which has 4,000,000 people. But there is here an inexhaustible field for investigation and speculation. We leave it to others to explore, having fulfilled the task we set ourselves, of calling the attention of those who inaugurate or direct great enterprises to the need of looking, in arrangements for the future, to a longer period than the decennial census, which is the limit of all speculations on the subject of population and growth which I remember to have seen in print. Twelve hundred millions of intelligent, educated, industrious people, of one race and blood, under one free government, armed with all that science teaches and man has invented — who will wish to interfere with their happiness? Who will attack them?

The probable increase in the ten years from 1930 to 1940 will be about 68,000,000. This is equivalent to 13,600,000 families. Considering only the building trades, this will require the construction in ten years of 14,000,000 new domiciles or family residences. Each will need as much floor and window area as now. Does any one yet foresee the volume of business and its activity, in constructing within a single decade as many buildings as at this time exist within the limits of the United States?

What work for architects, contractors, builders, carpenters, masons, brick-layers, plasterers, brick-makers, quarriers, saw-mills,

lime-kilns, sand-gatherers, rolling-mills for structural and roofing iron in sheets and beams, for tinners and roofers, and the thousand other trades engaged in construction, not only of the 14,000,000 new homes, but of the markets, stores, warehouses, post-offices, court-houses, city-halls, jails, penitentiaries, etc., necessary in the administration of an additional population equal to all that exists now on the northern continent! What will be the work of providing, and delivering at every house, three meals a day, and every day, for each inhabitant thereof? M. C. MEIGS.

BACTERIA IN MILK AND ITS PRODUCTS.

DURING the past year, investigations on the bacteria of milk have been carried on in the laboratory of the Agricultural Experiment Station, Mansfield, Conn., under the direction of H. W. Conn, professor of biology in Wesleyan University. The following is a brief summary of some of the more interesting results of this work.

The term "bacteria" is used to comprise a class of organisms found abundantly in the air, water, and soil, and in plants and animals. As commonly employed, the term includes a large variety of organisms, which naturalists divide into the three classes, bacteria, yeasts, and moulds. The term "microbe" has been recently introduced to cover this same ground, and is for many reasons preferable. The plants included under this head are exceedingly numerous, and the part they play in nature is of great importance. They multiply with the greatest rapidity, a single individual in the course of a few days being able to give rise to millions. While they are thus growing and multiplying, they produce great changes in the medium in which they grow. All fermentation (such as raising of bread, fermenting of beer, cider, etc.), putrefaction and decay (such as rotting of potatoes, decay of wood, etc.), are produced by the organisms here included. They are of immense value as well as injury. Through their agency, dead animal and vegetable matter is decomposed, and prepared to be incorporated with the soil and to be used as food by plants. It is doubtful if vegetable life could be long continued without their aid. On the other hand, they cause disease in plants, and disease in animals; many of the most dangerous diseases, as cholera, typhoid-fever, consumption, hog cholera, bovine tuberculosis, chicken cholera, etc., being produced by these disease germs. These organisms are extremely minute and simple. They are commonly not more than one two-thousandth of an inch in length. In shape they show three chief varieties, which may be compared to a lead-pencil, a ball, and a corkscrew. To-day they are universally regarded as plants, in spite of the fact that many of them are endowed with motion.

Methods of Experiment.

The method of experiment has been that common in modern bacteriological research. For culture solutions the ordinary beef peptone solution, stiffened by gelatine, or more commonly by agar-agar, has been used. For most of the experiments with cream, "ripened cream" has served as a starting-point. In some cases sweet cream has been ripened in the laboratory, and examined each day, but more commonly specimens of ripened cream have been obtained from the dairy of a butter-maker and directly studied. Plate cultures have been made from the cream, usually with agar-agar, since the organisms found grow in this medium most readily. From the various colonies found in the agar plates, needle cultures have been made in gelatine. Subsequent purification of the organisms has been made in the ordinary way, by transferring from tube to plate, and plate to tube, until the bacteria were separated from each other in pure cultures.

For further experiment, milk has been sterilized in test-tubes. This can be done at a temperature of about 70° C., but it has been found more convenient to put the tubes for a few minutes in a steam sterilizer. Sterilization upon three successive days is commonly sufficient, but in a few cases milk was found to change even after such treatment. The sterilization of cream has been accomplished in the same way. There is more difficulty in this, however, for the cream is apt to form a thick layer on the surface, with a thin watery layer below; and this occurs even in cream that is thoroughly sterilized. In the experiments upon the action of the different bacteria upon milk, the inoculations have been made, and the tubes allowed to remain at the temperature of the laboratory for a day or two. If no change occurs, they are then placed in a thermostat at a temperature between 30° and 35° C., and allowed to stay there till they have produced their effect upon the milk.

Accompanying all of the experiments upon milk and cream, a series of experiments have been carried on with the same organisms upon three different solutions. One was the ordinary beef peptone solution without gelatine; the second, the same solution, to which a small amount of milk-sugar had been added; and the third, the beef peptone solution, with the addition of glucose instead of milk-sugar.

Inasmuch as the object has been to determine the general effect upon milk and its products of the various bacteria present in the air, it has been necessary to work with all the numerous species that have been found in ripened cream. This has necessitated a very large number of experiments, continuing through eight months. The account of these experiments, which, to be in any way useful, will require a large number of pages of detailed description of individual species of bacteria, as well as their action and effects, is reserved for the next annual report of the station. At present it is designed to give only a brief summary of the most important facts concerning the relation of bacteria to milk and its products. For this reason the following remarks include results of the work done at the station, and of other investigators as well, and some conclusions derived from them.

Bacteria in Milk, Cream, and Butter.

Milk is a medium in which bacteria grow with the greatest readiness. Experiments have thus far given indication of some thirty or forty species of bacteria that are floating in the air in this vicinity, every one of which is found in cream, and grows with the greatest facility in milk. Probably none of those which were studied produce disease, and hence are called non-pathogenic. The researches of others have shown that many of the disease (pathogenic) germs also find in milk a favorable medium for growth. According to experiment, cream seems to be even a better medium for the growth of bacteria than milk; for it will keep longer without putrefying, and thus allow some of the slower-growing species to develop. Butter is not a good medium for the growth of bacteria, apparently because they require for their development a certain amount of albuminous material, of which good butter, being mostly fat, contains only a minute amount. Bacteria have, however, always been found present even in the sweetest of butter, but usually in small numbers. When for any reason they become very numerous, the butter becomes tainted.

If milk, cream, or butter is kept free from bacteria, the ordinary changes do not take place in them. For example: the bacteria in milk can be readily killed by heating the milk to a boiling or even lower temperature for a few moments upon three successive days; and then, bacteria being excluded, the milk is found to keep sweet indefinitely. Killing the bacteria by heat is known as sterilizing. If a lot of milk is thus sterilized, and then a few of any particular species of bacteria are put into it, the effect which this species produces upon the milk can very easily be determined. It is in this way that the experiments have been made.

Milk and cream under ordinary conditions cannot be kept free from bacteria. Milk drawn from a healthy cow is free from them, but they may get into it when the milk is in contact with the air during milking. A single experiment will indicate the difficulty of keeping them out of milk. Eight test-tubes were washed perfectly clean, and plugged with a mass of cotton. They were then heated very hot until all living matter in them was killed. These were taken into a milking-yard, and, after the teats of the cow and the hands of the milker had been carefully washed, the cotton plug was taken out and milk drawn directly from the cow into the tubes, and the cotton plug replaced. Of these eight tubes, seven soured in a few days, and many bacteria were found in them. The other remained sweet for a long time, but eventually it also changed. From this experiment it is seen that in the few seconds in which it was exposed to the air the milk was contaminated with bacteria. A very common source of contamination of milk is from

vessels in which the milk is placed. These, unless recently washed in boiling water, contain bacteria clinging to their walls. These bacteria begin to grow as soon as the milk gets into the vessels, and in a few hours will multiply so as to be extremely abundant.

Number of Bacteria in Milk. — Different Species.

The number of bacteria in milk will depend chiefly on three things: 1. The cleanliness of the vessels; 2. The temperature of the milk, warmth being favorable to their growth; 3. The length of time that the milk has been standing. Ordinarily the number of bacteria in the air is of comparatively little importance, unclean vessels being the great source of contamination. If, however, the vessels are perfectly clean, the number of organisms in the air becomes the important factor. In cream which has been allowed to "ripen" for a few days, the number is extremely great. In the specimens of ripened cream which we have examined, from 10,000 to 100,000 individuals have been found in a single drop, the latter number being usually nearer the truth than the former. Even under conditions most unfavorable for their growth, in a cool cellar during the winter, 12,000 have been found in a single drop. These are capable of multiplying with the greatest rapidity, producing hundreds of thousands in a few days.

Not only is the number of individuals very great, but the number of different species is considerable. Some thirty or more different species of bacteria have been found during the winter in specimens examined in the laboratory. No single specimen of cream contained them all, but each contained several species.

The number of bacteria present has, however, no significance until we know something of their effect. Some are harmless, some are hurtful; some affect cream, milk, and butter injuriously, and others do not. The effect produced by most of these organisms upon milk is striking.

Of the large number of organisms found in milk, two or three seem to be characteristic. The first is the one that produces the ordinary souring of milk (*Bacillus acidi lactici*). This organism, upon being introduced into sterilized milk, grows rapidly, and soon breaks up the milk-sugar that is present into either lactic or acetic acid and carbonic acid. The acid thus formed causes the milk both to curdle, by hardening or coagulating its albuminous matter, and to acquire its well-known sour taste and odor. This organism is very abundant in the air in warm weather, but in the winter seems to be much less abundant: indeed, it can at times almost be said to be absent. Milk has been kept in an open dish in the laboratory, during cold weather, for two weeks without its going through the characteristic changes of souring. It finally curdled, but with a peculiar odor of decay, and did not sour in the typical manner at all. The vessel in this case was absolutely clean, so that the air was the only source of contamination. The changes which did take place were produced by bacteria other than the common sour-milk bacterium, this one not seeming to be present at all. The fact that the typical souring was thus prevented shows that the common sour-milk bacterium was not present in the air at the time, at least in any great quantity. Such an experiment would not succeed in the summer.

A second species almost always found in milk is *Oidium lactis*. This produces no important change in milk. It grows rapidly, but does not cause the milk to sour or curdle. Besides the two mentioned, a large number of other species have marked effects upon milk.

Action of Different Kinds of Bacteria in Milk.

As concerns their action, we may divide them into four classes: 1. Some, like the bacteria of sour milk, cause the milk to sour by breaking up the milk-sugar into lactic or acetic acid and carbonic acid: curdling of the milk results. 2. Many produce the same result, but only at somewhat higher temperatures. At ordinary temperatures, they grow, but do not curdle the milk; in a warm oven, however, the milk will soon curdle. Accordingly, these would sour and curdle the milk in summer, but would not do so, or would do so less readily, in winter. The temperature and time required to produce the curdling differ with different species of bacteria. 3. Some do not have the power of breaking up milk-sugar, do not produce any acid, and do not coagulate the milk. The milk remains liquid, and sometimes becomes decidedly alkaline. 4. A few species curdle the milk, but produce no acid, the milk becoming alkaline instead. The majority of bacteria of milk and cream which have been experimented upon produce a souring and curdling of milk at some temperature. Experiments have also indicated that the action in all these species is somewhat similar; i.e., the breaking-up of the milk-sugar into an acid and some other product. But, although the action is thus fundamentally the same, the details of the action vary with each different species of bacteria.

The curdling is very different in character with different species. In some cases a hard curd and a clear liquid are formed; in others a curd is formed, but no liquid is separated from it; in still other cases the whole milk is turned into a semi-gelatinous mass. Sometimes the curd is easily broken or cracked, like the curd of common milk; in other cases it is very tenacious, sticky, and slimy. Sometimes the curd is dissolved in a few days, and the milk is left as a clear and almost transparent liquid. Here the caseine seems to undergo a change similar to digestion; i.e., conversion into peptones.

In connection with the curdling, there also arises in all cases a characteristic odor, which differs with different species of bacteria. There is a sour smell, a smell like sour bread, a smell like soft-soap, like salt mackerel, like a pig-pen, like the barnyard, and in many cases a smell of putrefaction. Besides these, there are others that cannot be described because of the lack of words in our language to distinguish odors. As far as the studies have gone, the effect of each species of bacteria upon the milk seems to be different from all others. The dairyman or the housewife would in most cases say that the milk had soured, but careful study shows that in reality the different bacteria do produce effects differing to a greater or less extent. The results of the experiments seem to indicate that what is commonly known as the souring of milk is not always caused by the common sour-milk bacterium, as has been usually supposed, but is frequently produced by others, and that the products formed are different. Particularly is this true in winter.

Bacteria in Cream.

Experiments were undertaken in the expectation that the so-called "ripening" of cream would prove to be a definite change due to the growth of bacteria. Having found that the souring of milk is less simple than had been supposed, one is prepared to find that the "ripening" of cream is also a complex process. It is not easy to say just what is meant by "ripened" cream. In ordinary farm practice, cream is usually allowed to stand for a few days before churning, when it becomes somewhat thickened, and acquires a pleasantly sour odor. In the creameries the cream is also ripened, though for a shorter time, and it does not become so thick or so sour. That the ripening is due to the growth of bacteria there can be no doubt. Ripened cream always contains these organisms in almost inconceivable abundance. In some places the ripening is hastened by adding a little sour cream as a "starter." This simply means the addition of a large number of bacteria, which of course hastens the process. Sometimes an artificial starter in the form of an acid is added. This practice proceeds upon the supposition that the ripening is due to the formation of an acid, which is probably a secondary matter. It is doubtful if this kind of a starter has any definite value.

By successive heatings, specimens of cream have been deprived of all bacteria, and it is then found that the cream remains unchanged indefinitely. In these specimens of sterilized cream have been planted the various species of bacteria that have been experimented upon. All of them grow well in the cream, and each has its characteristic effect; but no one of them has yet been found to produce exactly what would be called ripened cream. Some curdle it; some cause it to putrefy. From all of the experiments it may be concluded that the ripening of cream is a complex matter. The souring is apparently due to a process similar to the souring of milk; the thickening, in part to the curdling of the small amount of milk left with the cream, and in part to immense numbers of bacteria that develop. Another important factor in the ripening of cream is the decomposition of the albuminous matter present. In general we infer that different kinds of bacteria assist in the ripening of cream, but doubt whether any one has such a definite

relation to it as the sour-milk bacterium has to the curdling of milk.

Objects of the Ripening of Cream.

There seem to be two chief objects in ripening cream. It is a matter of experience that the butter will separate more readily from ripened cream, and the churning therefore be easier; and it is believed by many that the butter made from ripened cream will keep longer than butter made from sweet cream. A simple explanation is suggested, if not warranted, by the facts at hand, and may be of interest to butter-makers. Dr. Babcock of the Wisconsin Agricultural Experiment Station has pointed out, that, shortly after milk is drawn from the cow, there appears in it a fine, inappreciable network of fibres, which produce in the milk a slight thickening somewhat like the clotting of blood, except that it is much less marked. This, which Babcock calls "fibrine," is of an albuminous nature, and will readily putrefy. When the cream rises to the surface of the milk, a considerable quantity of this so-called fibrine is entangled with it, and is skimmed off with the cream. The butter-globules are enclosed in this fibrine, and in churning they must be shaken out. Now, in the time that the cream is ripening, the numerous bacteria are at work upon this albuminous fibrine, feeding upon it and decomposing it. The breaking-down of the fibrine is also assisted by the acid that is formed by the bacteria, for it is a well-known fact that acid will greatly assist in the solution of materials similar to this fibrine. After the fibrine is thus partly dissolved by the action of the bacteria, the butter-globules will much more readily be shaken free from them, and churning be made easier.

The keeping-property of the butter is easily explained by the same considerations. There is no doubt that bacteria are the cause of rancidity in butter. Bacteria cannot live upon pure fat, but require for food a certain amount of albuminous matter. It follows that the more albuminous matter there is in the butter, the more readily will they grow, and the quicker will the butter become bad. If the cream is churned before the albuminous fibrine has become decomposed, the butter will usually contain more of the fibrine than will butter made from cream after the fibrine has decomposed. Butter made from ripened cream will naturally contain more bacteria than that made from sweet, since the ripened cream itself contains them; but this is a matter of less importance than the ability of the bacteria to grow and multiply in the butter, and, for reasons above stated, this they can more readily do in butter made from sweet cream.

From this it would seem that the value of ripening cream depends upon the albuminous fibrine that is present in the cream; and any process that diminishes this diminishes the necessity of ripening, at least so far as concerns the two objects above mentioned. Babcock has shown that the quicker the cream rises, the less will be the amount of the fibrine entangled with it; and that, when cream is separated by a centrifugal machine, a considerable part of the fibrine collects on the drum of the machine, and less in the cream. It would seem, therefore, that there would be less need of ripening centrifugal cream than that raised in the more common way.

A third object attained by ripening cream is to give a certain flavor to the butter which is not obtained in butter made from sweet cream. This is a matter of as much importance to butter-makers as either of the other two, for the value of butter usually depends more upon its taste than upon its keeping-properties. But the relation of the taste of butter to the ripening of the cream, and to the method of handling the butter, is a matter too vague and indefinite at present to warrant definite statements.

Cleanliness in Dairying.

It must be remembered that many bacteria are so minute that thousands of them might occupy less space than the point of a needle; that they multiply so rapidly that millions may be produced in a short time from a single one; that organic (animal and vegetable) matters, including many forms of what are ordinarily called dirt, are media for them to grow in; that milk is especially adapted to their development, and the most minute quantities of it may serve for their dwelling-place, and furnish food for their rapid growth; and that they are sure to adhere to the surface or cling in the joints of vessels that have contained milk. Bearing all of these facts in mind, the necessity for thorough cleansing of all vessels used in handling milk is apparent. To wash such vessels so that no particles of dirt will remain on the surface or in the joints is extremely difficult. It has been frequently demonstrated that no amount of washing in cold or even warm water will remove all bacteria. It is necessary to use boiling water, and to leave it in the vessels for a considerable time, to destroy the active forms of bacteria that are sure to be present. Even though the active forms may be killed by boiling water in the course of a few minutes, their spores, which correspond to seeds, will resist boiling temperature for a long time. The danger of contamination from spores is not so great but that it may be neglected for all practical purposes, and, unless the vessels are contaminated with some dangerous bacteria, a thorough washing in boiling water is sufficient. But vessels in which milk is to be kept cannot be properly cleaned by pouring boiling water into one, allowing it to remain there for a few minutes, and then pouring it into another, and making one heating of the water suffice for the cleaning of several vessels. The last ones thus treated will not be much cleaner, so far as bacteria are concerned, than if they were washed with cold water. To clean vessels thoroughly, it is necessary to use a higher temperature than that of boiling water, which can be readily obtained by putting them for a few minutes in a hot oven or on a hot stove. If this is thoroughly done, there is no danger of contamination of milk from the milk-vessels.

The use of sal-soda in washing milk-vessels is advantageous, because it acts chemically upon fatty matters (grease), and thus helps to remove them and other materials which adhere to the vessels with them. In like manner, the use of "live steam" to "dry" vessels after washing has the advantage of sterilizing them; i.e., killing the bacteria by the highly heated steam.

BOOK-REVIEWS.

The Ice Age in North America and its Bearings upon the Antiquity of Man. By G. F. WRIGHT. New York, Appleton. 8°. $5.

IT may perhaps be questioned whether the time has yet come for a popular presentation of the glacial theory in so detailed a form as is given in Professor Wright's book, for it is still a matter upon which much investigation must be expended; but, on talking with teachers and intelligent readers who have not access to the scattered literature of investigation, it is apparent enough that they greatly need a compendium of the results of glacial study as it now stands, as they have no sufficient comprehension of its remarkable conclusions. This book on the ice age in North America will therefore have a wide reading, and, if its readers note carefully the expressions of doubt as well as the expressions of fact, it must be serviceable to them. Professor Wright's style is entertaining, and he brings together a large and well-selected body of description from the works of pretty much all the glacialists in the country. The illustrations are excellent, and the citations are numerous; but, for the sake of historical precision, it would have been better to add the date of publication of the writings of others, and it might have been advisable for the author to place the "Report of the Ohio Geological Survey," and several other papers, before his own in the extended list of essays on our terminal moraines (p. 139), to which the studious reader is referred.

The book opens by discussing the nature of glaciers in general, and illustrates this by descriptions of our glaciers in the West, and by the author's account of his observations on the Muir glacier in Alaska in 1886. Glaciers in Greenland and other parts of the world are then allowed two chapters before taking up the indications of extinct glacial action, to which the rest of the volume is devoted. Some of the more important headings are, "The Glacial Boundary and Terminal Moraines," "Glacial Erosion, Transportation, and Deposition;" "Contrasts of Pre-glacial, Glacial, and Post-glacial Drainage;" "The Date of the Glacial Period and its Relation to the Antiquity of Man."

If one may judge by the small attention given to glacial topography in our ordinary text-books on physical geography, it may be

concluded that there is no general appreciation of its great significance. One may hardly find a history of the United States that does not give an introductory account of the early Indians; and yet it is safe to say that they are of less importance in forming an understanding of our historic progress than the work of the old glaciers is in gaining a conception of our geography. The moraines and drumlins, the kames and sand-plains, the lakes, falls, and gorges, the gravel-filled and terraced valleys that characterize the northern glaciated country, are, to be sure, relatively small topographic forms; but they are forms on which we live, and which we daily see around us. It is proper that they should be introduced to public notice; and Professor Wright's book will certainly aid in calling attention to them, particularly if his readers go further than his text, and follow up his footnotes, through which they will be led to the most important discussions on these subjects. Look, for example, at the illustration of a new river-course marked by a waterfall, or of an old river-course blockaded into a lake, both of these excellent views being copied from Chamberlin and Salisbury's invaluable essay on the driftless area of Wisconsin; or at the strongly marked morainic wall of the Kettle range in Wisconsin, taken from one of Chamberlin's reports; or at the extraordinary loops of the moraines in Minnesota and Dakota, taken from Upham's and Todd's figures; or at the drumlins reproduced from Hitchcock's report on New Hampshire; or at the map of the kames of Maine by Stone. All of these are not only valuable illustrations of highly significant topographic forms, they are also tempting suggestions towards study of the original sources on which Professor Wright has drawn freely in preparing his book. The same may be said of numerous quotations, often extended over a page or more, from the writings of those who have given us the best interpretations of glacial geology. There are extracts from Gilbert's and Pohlmann's papers on the recession of Niagara Falls; Winchell's account of the post-glacial recession of the Falls of St. Anthony; Upham's description of Lake Agassiz, now the great wheat-growing plain of Minnesota and Dakota; Claypole's suggestive although rather highly deductive account of the temporary lakes marginal to the retreating ice-sheet; Newberry's studies on pre-glacial drainage; and many more. The thoughtful reader of all this will perceive something of the long growth of the present belief in glacial geology, and of the efforts of the many workers who have so greatly contributed to its understanding. Professor Wright's own observations on the margin of the glaciated tract are of course also described.

Among the questions on which the conclusions favored by the author are most likely to find dissent with some investigators are the date and duration of the glacial period, and the ice-dam at Cincinnati, by which the Ohio was blocked into a great lake. The objections to the latter theory are not so much on account of its inherent improbability as because the effects and products of such a lake have not been as yet clearly enough seen to require a moderate sceptic to admit its existence. It is natural enough for Professor Wright to feel a paternal fondness for this idea, which he originated some years ago, and look with favor on facts that point towards it; but, before it can command general acceptance, it must be examined in the light of a broader view of the evolution of rivers and of the various changes to which they are subject. It does not seem as if this broader view has been attained, for it is said that the Ohio has been at work on its present valley from the first elevation of the continent to glacial time, that is, through all mesozoic and nearly all cenozoic time; while it must be apparent to the student of river history that the present valley of the Ohio is of by no means so great an age. The water-worn pebbles on high land in West Virginia have relatives in similar deposits in Tennessee, outside of the hypothetical Ohio lake. The terraces of western Pennsylvania are not described in such a way as to make it clear that they are of lacustrine and not of fluviatile origin. The case had best stand open yet for a time till further facts are developed.

The date of the glacial period commonly alluded to, as determined by such post-glacial river-gorges as the Niagara, is rather the date of a somewhat late phase in the disappearance of the ice. How long a time elapsed from the maximum advance of the ice to the beginning of work on the gorge is not now determinate. The unknown factors in this problem are very numerous, and they will require much labor in their definition. Prominent among these is the time-interval between the various terminal moraines and drift margins; and in this question, Wright differs from the conclusions of Chamberlin, McGee, and Gilbert, as to the division of the glacial period into two distinctly separate epochs, and regards the whole period as essentially single and continuous. Extracts are given from the writings of the above-named investigators; but the reader will do well to consult the original essays, as the discussion is rather intricate. Here, as in the case of the ice-blocked Ohio, it appears to me that Professor Wright does not sufficiently consider other arguments than those of strictly glacial geology. The evidence of topographic development, as adduced by Chamberlin and McGee, particularly needs further examination.

On these larger questions, it is to be hoped that an open mind can be maintained for some years to come. It is only by regarding them as settled that the student may be unwisely guided. The treatment of the smaller subjects, such as those of which many examples have been named above, will prove instructive to many readers.

W. M. D.

An Elementary Treatise on Mechanics. Part I. Statics. By ISAAC WARREN. London and New York, Longmans, Green, & Co. 16°. $1.

THIS is a compact and well-arranged little volume, intended for the use of schools and students in universities. It is the first part of a work on mechanics, the second part of which will treat of dynamics, under which term the author includes kinematics and kinetics. The work follows to a great extent the same lines as those of the same author's elementary treatise on plane trigonometry, and is especially rich in exercises, — a feature which ought to recommend it to teachers. As additional exercises, a series of ten examination-papers proposed in Trinity College, Dublin, are annexed to the volume, and a note on the order of lever to which the oar belongs. This latter, though a clever thing in itself, and well adapted to develop certain faculties of the youthful mind, might well be omitted in a text-book.

Steam Engine Design. By JAY M. WHITHAM. New York, Wiley. 8°. $6.

MECHANICAL engineers, students of engineering, and draughtsmen will find this a book well adapted to their requirements, and it will not be without value to any person interested in mechanical engineering as a profession. Its author was at one time assistant engineer in the United States Navy, and is now professor of engineering in the Arkansas Industrial University. The work treats of the application of the principles of mechanics to the design of the parts of a steam-engine of any type or for any duty, and also of auxiliary attachments and constructive details. The best and most approved engineering practice, evidently, has been drawn upon freely for the examples with which the book abounds; and the illustrations, of which there are a profusion, are, with one or two exceptions, excellent specimens of the engraver's art.

The more general elements pertaining to steam-engine practice, such as types of engines, clearance, piston speed, friction, fuel, weight of parts, and radiation of heat, are discussed in a brief introduction, after which pistons, slide-valves, and valve and reversing gears receive a chapter each. A separate chapter is devoted to the steam-chest, stuffing-box, link, eccentric, etc. A description of the principles of the compound and triple-expansion engines is condensed into one chapter, though the growing importance of this branch of the subject would seem to warrant a more extended and detailed treatment of it. After a brief chapter on indicator-diagrams of a compound engine, a chapter each is given to crank-effort diagrams, the relation of friction to the turning-power of the engine, the piston-rod and its cross-head and guides, the connecting-rod, and the crank-pin. Then comes a long and full chapter on crank-arms, crank, line and propeller shafts, bearings, and couplings; one on condensers and pumps; and one on the engine-frame, pillow-blocks, reversing-engines, walking-beams, etc. The screw-propeller and paddle-wheels, both radial and feathering, are treated of in the final chapter; and a short appendix is devoted to the strength of materials and a saturated-steam table.

The volume contains 210 illustrations, many of which are folding inserts. A very full and well-arranged index fittingly completes the work.

AMONG THE PUBLISHERS.

ROADS and road-making are ably discussed by Capt. Francis V. Greene in the supplement to *Harper's Weekly* for Aug. 10.

— J. B. Lippincott Company will soon publish Mr. George W. Childs's "Recollections," parts of which have appeared in *Lippincott's Magazine*.

— Macmillan & Co. will publish in September a revised edition of Bryce's "American Commonwealth." It is said that ten thousand copies of this work have been sold in the United States.

— *Wood's Medical and Surgical Monographs* for September will contain a practical work on the art of embalming, something unique in our medical literature.

— A. Lovell & Co., 3 East 14th Street, New York, will publish early in September a volume on the "Honors of the Empire State in the War of the Rebellion," by Thomas S. Townsend, the compiler of the well-known "Library of National Records."

— Thomas Whittaker will publish at once a new revised and enlarged edition of King's "Classical and Foreign Quotations." The first edition was exhausted three months after its appearance, and the author has been engaged on the revision since that time.

— A lady in one of the New England towns recently returned a copy of Robert Louis Stevenson's story "The Wrong Box" to her bookseller, for the reason that the cover was "defaced by a newspaper scrap, which, although I have applied soap and water, I have been unable to remove." So much for an attempt at novelty in book-making.

— Henry Holt & Co. have in hand a second "History of the United States," the manuscript of which was left with them ready for the press by the late Professor Johnston of Princeton. It was written on a plan somewhat similar to that of his already well-known text-book, but suited to a shorter course, and perhaps to less mature minds.

— The historical treatise on Columbus, for which a prize has been offered by a Spanish commission, must be delivered to the secretary of the Royal Academy of History, at Madrid, before the 1st of January, 1892. Works written in Spanish, Portuguese, English, German, French, or Italian, may enter the competition. The two prizes amount respectively to $5,700 and $2,895; each of the two successful authors receiving, besides, five hundred copies of his work.

— The New Haven Colony Historical Society will publish at once a compilation of the inscriptions in the old Milford graveyard prior to 1800. The transcription will be literal, the type being varied to represent as nearly as possible the appearance of each stone. The work will fill seventy pages, and will be illustrated by facsimiles of seventeen of the most interesting stones. Genealogical notes by Mr. Nathan G. Pond, the transcriber, will be included.

— The Worthington Company have secured for America an edition of the supplementary new volumes of the Villon Society's renowned version of "The Book of the Thousand Nights and One Night." The Arabic text of two favorite stories in the collection — "Aladdin; or, The Wonderful Lamp," and "Zeyn Al Asnam and the King of the Genii" — has at last been discovered in a manuscript recently purchased by the Bibliothèque Nationale at Paris.

— Scribner & Welford have just issued the sixth volume of the Henry Irving Shakspeare, which was delayed by the illness of the editor, Mr. Frank A. Marshall. This volume contains the plays of "Othello," "Antony and Cleopatra," "Coriolanus," and "King Lear." A prefatory note explains that it was intended to print "Hamlet" here instead of one of the four plays given, but that the revision of the proofs had not been finished when Mr. Marshall's health broke down. Two new artists are represented here, the illustrations to "Antony and Cleopatra" being by Mr. Maynard Brown, and those to "Coriolanus" by Mr. W. H. Margetson. The introductions have been written by Mr. Joseph Knight and Messrs. Wilson Verity and Arthur Symons.

— Mr. Lodge's volumes on Washington, recently published in the series of American statesmen, have been warmly praised by many critics, but perhaps the most valued approval is that from the Nestor of American historians, Hon. George Bancroft, who writes to the publishers as follows: "I like your new work on the unique man of the last century exceedingly. It is written independently, as well as with a full sense of the unique greatness of Washington. You did your part nobly, and gained honor and a claim to gratitude by publishing so valuable a volume.

— The author of "Micah Clarke," the historical novel recently published by Longmans, Green, & Co., is an English physician who is only thirty years old, and who has been a writer of magazine stories for ten years past. Dr. A. C. Doyle is a tall, athletic young man, who not only attends to a good practice and writes novels, but is a famous cricketer. He has, moreover, seen service on the West African coast, and has roughed it in a whaler. He is a nephew of Richard Doyle, the *Punch* artist, and illustrator of "The Newcomes."

— The Worthington Company, in addition to the announcements already made, are preparing the following books for the fall. First in importance is a new edition of "Taine's English Literature," with an introductory essay by Richard H. Stoddard, which enables them to copyright the book. "The Memoirs of the Count de Grammont" will be brought out as a holiday publication with photogravures and portraits. There will also be *éditions de luxe* of Macaulay's "Lays of Ancient Rome" and Main's "Treasury of English Sonnets."

— D. C. Heath & Co. have just published "Modern Facts and Ancient Fancies in Geography," a handbook for teachers, by Jacques W. Redway. This book will treat the subject in the light of modern science, and suggest some new methods of teaching this much-abused subject. They have also just ready "Topics in Geography," by W. F. Nichols. This is not a text-book, but a specific course, a systematic enumeration of the items or classes of items to be taught in each of the grades, with something of the methods of presentation, all built upon the general plan of language-work done in our schools. The "topics" have been prepared for seven grades, beginning with the lowest.

— Mr. C. H. Lee of Leesburg, Va., great-grandson of the eminent statesman Richard Henry Lee, is, according to a correspondent of the New York *Evening Post*, engaged in writing the memoirs of his illustrious ancestor. Mr. R. H. Lee was the friend of Patrick Henry, and in warm concurrence with him in disdain of the acts which led to the war of the Revolution. The Tory party had pronounced him a "political demagogue," but those on the other side, approving his resistance to oppression, hailed him as the "young reformer." The "Life and Correspondence" of R. H. Lee was published in 1829 by his grand-nephew, but the forthcoming work by a direct descendant will probably be fuller and more complete.

— A study of animal life and character is contributed by Olive Thorne Miller to the September *Popular Science Monthly* in the shape of a description of a pet lemur which the author possessed, and which represents a group of animals closely allied to the monkeys. The tariff question is discussed from a novel point of approach by Mr. Huntington Smith in "The Ethical View of Protection." The author lays down his points with considerable skill; and his article, which it is fair to say is adverse to the principle of protection, commends itself to the attention, if not to the acceptance, of readers of every shade of opinion. The number will contain an essay on the "Origin of the Rights of Property," by Henry J. Philpott. The author compares the views of a number of writers on the subject, points out wherein he thinks they are wrong, and draws his own bold and independent conclusion that the recognition of private ownership was in the beginning a truce in the war against its exercise by others. A paper by Professor Huxley bearing directly on the question involved in the recent discussion between himself and the Rev. Dr. Wace, concerning the genuineness of miracles, and entitled "The Value of Witness to the Miraculous," will also appear.

— F. A. Davis of Philadelphia has in press a new work on the "Practical Applications of Electricity in Medicine and Surgery," by Dr. G. A. Liebig, jun., of Johns Hopkins University, and Professor George H. Rohé of the College of Physicians and Surgeons, of Baltimore. The part on physical electricity, written by Dr. Liebig, one of the recognized authorities on the science in the United States, will treat fully such topics of interest as storage-batteries, dynamos, the electric light, and the principles and practice of electrical measurement in their relations to medical practice. Professor Rohé, who writes on electro-therapeutics, discusses at length the recent developments of electricity in the treatment of stricture, enlarged prostate, uterine fibroids, pelvic cellulitis, and other diseases of the male and female genito-urinary organs. The applications of electricity in dermatology, as well as in the diseases of the nervous system, are also fully considered. The work will be fully illustrated by engravings and original diagrams.

— The last regular article in the railway series will be contributed to *Scribner's Magazine* for September by H. G. Prout, editor of the *Railroad Gazette*, who will write of "Safety in Railroad Travel," explaining in a popular way many of those ingenious devices which have come into general use and have made railway travel the safest form of locomotion except walking. This article, which will be very fully illustrated, will explain, among other things, the Westinghouse air-brake, and complicated system of semaphore signals and interlocking switches, and crossing-gates, detector-bars, and automatic couplers. W. Hamilton Gibson will write on "Night Witchery," describing what may be seen of nature on a very dark night with other organs of sense than the eye. The article will be illustrated with a number of Mr. Gibson's most characteristic drawings. A. R. Macdonough will contribute the fourth paper in the fishing series, entitled "Nepigon River Fishing," in which he will describe one of the most attractive spots in Canada for all lovers of good sport. Lake Nepigon is two-thirds as large as Lake Ontario, filled with picturesque islands, and with strangely irregular shores. It is some distance from the line of the Canadian Pacific Road. Professor George Trumbull Ladd of Yale College will have in the number a very timely article on the "Place of the Fitting-School in American Education," in which he discusses certain plans for enabling the preparatory schools of the country to accomplish much better work than is now possible, so that they may send out their pupils as well educated at eighteen as they now are at twenty. Such changes he believes necessary in order to effectively raise the standard of American universities.

INDUSTRIAL NOTES.

Electrical Apparatus for Medical and Surgical Purposes.

THE engravings given herewith illustrate two pieces of electrical apparatus, manufactured by Charles Reitz of Indianapolis, and intended for the use of physicians and surgeons.

The office battery, shown in Fig. 1, is furnished with thirty-six

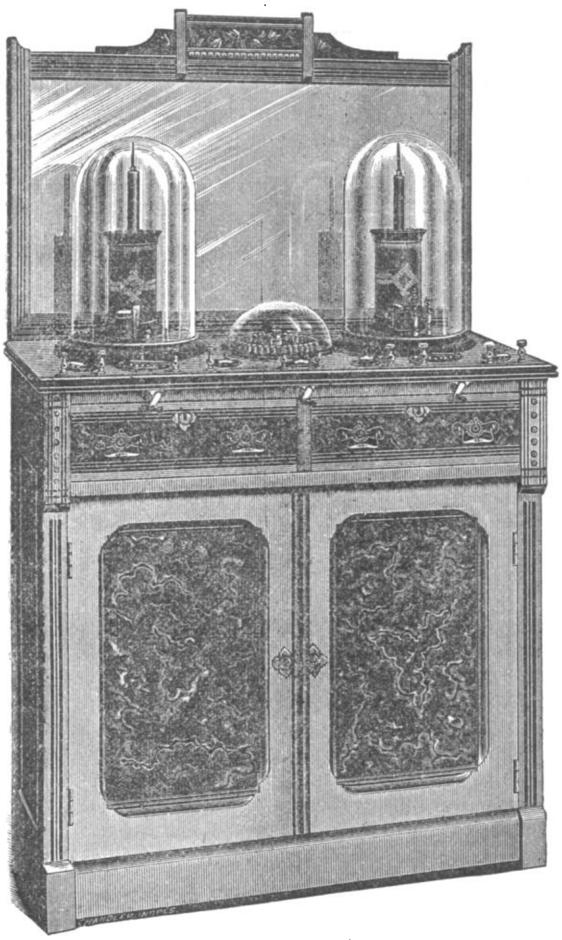

FIG. 1. — REITZ'S ELECTRICAL APPARATUS.

zinc-carbon cells, for galvanic current, and two electro-magnetic machines. The manufacturer claims that the battery may be used daily for a year without refilling. The cells are so arranged in the lower part of the case, that, when removed for refilling, no mistakes in connections can be made when returning them to their places. The jars are $3\frac{1}{4}$ inches square by $5\frac{1}{2}$ high. The porous cups are $1\frac{3}{4}$ inches in diameter and $4\frac{1}{2}$ inches high. The cells are connected to a hard-rubber switch-board in such a way that one cell after another may be added to the circuit, giving a current of any intensity, from that of one cell to the full power of the battery.

Each electro-magnetic machine has two large cells of battery of a capacity sufficient to run the machine from three to five hours with one filling, and they are so connected by a switch-lever on top that one or both cells may be used. The machines are kept covered by glass shades, the regulating-tubes in the coils being raised or lowered by turning a small crank in front of the case, the shades thus not requiring removal.

A magneto-electric generator and small incandescent lamp are shown in Fig. 2. The armature is of the Siemens type, $3\frac{1}{2}$ inches

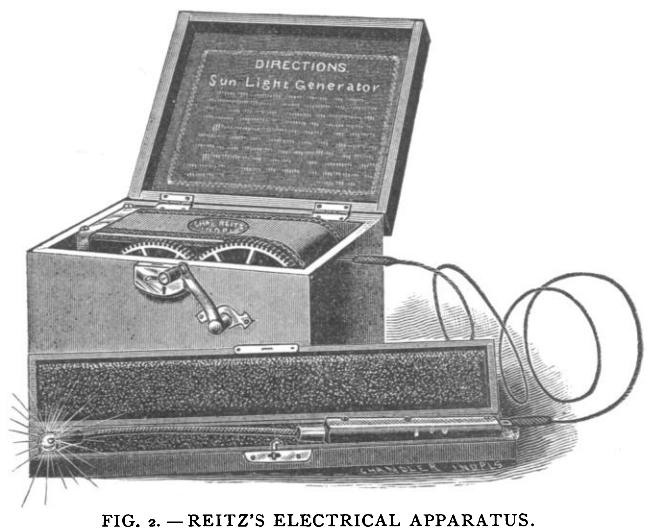

FIG. 2. — REITZ'S ELECTRICAL APPARATUS.

long and $1\frac{1}{2}$ in diameter, with $\frac{3}{8}$-inch bearings running in phosphor-bronze boxes. The lamp is one-half candle-power, and is mounted in a hard-rubber socket on the end of a flexible stem. It is a neat and convenient apparatus for the use of medical men.

Electric Motors.

The C. & C. Electric Motor Company of this city have just taken a contract to furnish a notable power-equipment for the works of the Hickox Manufacturing Company, ruling-machine makers of Harrisburg, Penn. The power-plant will consist of four C. & C. electric motors, three being of 20 horse-power, and one of 15 horse-power. The current to operate them will be taken from the Edison central lighting station. This installation is notable, both because of the amount of power used from large motors, and the fact that it is all derived from a central station.

Publications received at Editor's Office, July 8-Aug. 3.

ALLEN, A. H. Commercial Organic Analysis. Vol. III. Part I. 2d ed. Philadelphia, Blakiston. 431 p. 8°. $4.50.

COLLAR, W. C. Practical Latin Composition. Boston, Ginn. 268 p. 16°. $1.10.

ELSMERE Elsewhere; or, Shifts and Makeshifts, Logical and Theological. By a disciple of James Freeman Clarke. Boston, Wm. Macdonald & Co. 167 p. 24°.

FROEBEL, Friedrich, Autobiography of. Tr. by Emilie Michaelis and H. Keatley Moore. Syracuse, N. Y., C. W. Bardeen. 167 p. 12°. $1.50.

MACDONALD, D. Oceania: Linguistic and Anthropological. Melbourne, M. L. Hutchinson; London, Sampson Low. 218 p. 16°.

MERCUR, J. Elements of the Art of War. 2d ed. New York, Wiley. 302 p. 8°. $4.

NATIONAL Electric Light Association, Proceedings of the, at its Ninth Convention. Annual Meeting held at Chicago, Feb. 19, 20, and 21, 1889. Vol VI. Boston, Mass., Press of Modern Light and Heat. 261 p. 8°.

NEW JERSEY, Annual Report of the Board of Education, and the Superintendent of Public Instruction of. 1888. Camden, State. 241 p. 8°.

PEABODY, C. H. Thermodynamics of the Steam-Engine and other Heat-Engines. New York, Wiley. 470 p. 8°. $5.

SENSENIG, D. M. Numbers Universalized: An Advanced Algebra. Part I. New York, Boston, and Chicago, Appleton. 353 p. 12°.

Exchanges

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited. — E. E. BOGUE, Orwell, Ashtabula County, O.

Lead, zinc, mundic, and calcite. — Lulu Hay, secretary Chapter 350, Carthage, Mo.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for $2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4 × 5 pictures, in excellent condition; also one "new model" double dry-plate holder (4" × 5"), for fine geological or mineralogical specimens, properly classified. — Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc. — Alda M. Sharp, Gladbrook, Io.